VOL. 80 No. 2035
JULY 12 1958

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IN THIS ISSUE

Back to Polythene!	**56**
Polythene-Polyethylene Poll Results	**57**
Chemical Industry Safety Course	**59**
Distillates	**60**
Microbiology in North America	**61**
Winthrop Laboratories New Plant	**63**
In Parliament	**64**
Polarography at Achema	**65**
New Tin-Zirconium Alloy	**66**
Overseas News	**67**
Equipment Review	**69**
Foust Products Research	**71**
Chemist's Bookshelf	**72**
Fractional Melting Technique	**76**
People in the News	**77**
Commercial News	**78**
New Patents	**79**
Trade Notes	**80**
Market Reports	**80**

Annual subscription is: home, 52s 6d, overseas, 60s, single copies 1s 6d (by post 1s 9d)

CHEMICAL AGE

BOUVERIE HOUSE · 154 FLEET STREET · LONDON · EC4

WINDSCALE FUTURE

WITH the release of the final report of the three committees set up by the Prime Minister under the chairmanship of Sir Alexander Fleck, it is now clear that the No. 1 Windscale reactor is unlikely to be used again and there is every possibility that No. 2 will be dismantled in the near future. It is also clear that basically the cause of the accident was ignorance of the behaviour of materials in the process and insufficient instrumentation to keep a check on the reactor.

No final announcements have been made on the fates of the two reactors, but at a press conference last Thursday Sir William Cook, member of the UK Atomic Energy Authority for engineering and production, said that the first reactor was 'highly likely to be dead,' and the final decision would be known in a week or two. It will be two to four months before it will be known whether it is worth while starting up No. 2 plutonium reactor.

In considering the restarting of this reactor the factors to be taken into account are the cost of modifying it along the lines suggested by the Fleck committee which would be 'at least £500,000'. (Originally the Windscale reactors cost £3.7 millions each.) The reactor has also 'lived' seven of the 10 years of active life which had been expected of it when design was begun in 1946.

If it was decided to start Pile No. 2 again, it could not be operational before the end of 1959 or early 1960.

The recommendations of the Fleck committee now guiding the AEA's review of the future of its first two reactors include the fixing of hundreds of thermocouples, together with data-processing and display systems such as have now been developed for normal industrial use. Apparatus for the detection of fuel element failures would have to be available at all times. Existing filters would need to be improved. Also while the existing design of fuel cartridges is satisfactory, the present design of the lithium/magnesium cartridge (used for the production of tritium for military purposes) was unsatisfactory. They were too readily oxidised by air at the high temperatures reached during the Wigner release being carried out.

A further point is that a full study would have to be made of the performance under all conceivable pile operating conditions of all materials used for the production of isotopes, for experimental purposes, etc., before they are inserted in the reactor.

In these recommendations concerning the lithium/magnesium cartridges and the prior study of material to be used for experimental purposes, we have a hint, as was suggested at the time, of the Penney report on Windscale (see CHEMICAL AGE, 16 November 1957, p. 799) that the accident at Windscale could have been due to faulty lithium/magnesium cartridges.

Mr. H. G. Davey, general manager at Windscale, reported at the conference that some of the cartridges were, in fact, burnt during the accident. Also, though the Penney committee's view was that it was unlikely that one of these cartridges and not an ordinary fuel element started the fire in the pile, Mr. Davey said that it was 'impossible to tell after the event' which had burnt first.

Many of this final report's recommendations deal with the Wigner release.

Consideration has been given to the release of Wigner stored energy in Windscale Pile No. 2. The results of the release of Wigner energy by a new method carried out on BEPO during March this year have been made known to the committee. The final Fleck report indicates, in fact, that neither the BEPO type release nor the slow heating method (as previously practised at Windscale) by itself appears to be acceptable for No. 2 reactor, but there is a possibility of combining the two methods to produce a satisfactory technique. Thus the graphite temperature would first be raised slowly to 120°C by heating the ingoing air and would be maintained at 120°C for about 12 hours; the pile would then be cooled down to room temperature. This preliminary heating would remove some of the higher energy and reduce the maximum graphite temperature that might be reached in a subsequent self-sustaining release by about 80°C; the maximum graphite temperature would then be within acceptable limits. Second, the graphite temperature would be raised rapidly to about 160°C again by heating the ingoing air, to bring about the release of the remaining low temperature stored energy.

The possibility has also been examined of operating Pile No. 2 without further planned releases by controlling strictly the operating temperature of the graphite. It would be possible, the committee indicates, to specify conditions which would make this course feasible. In operating the pile under such conditions, however, there would inevitably be a loss of flexibility in the loading and use of the pile.

Besides the cost involved in installing adequate numbers of instruments and other processing systems and modifications, said to be about £500,000, and the remaining life of Pile No. 2, there is the cost of the plutonium which would be produced to be taken into account. Even at the time of the accident, Windscale plutonium was more expensive than from the Authority's Calder Hall reactors. There will soon be eight reactors producing plutonium—four at Calder Hall and four at Chapel Cross.

Calder Hall reactors are so designed that Wigner releases will have to be carried out much less often, if at all. (At Windscale, releases were necessary every six months.) The committee says in its report that there would be no need for a release for at least another two years.

The idea that neither pile is likely to be used again is substantiated further by statements made by Mr. J. Fletcher of the AEA in response to questions about the concrete shield about the first pile. This would be sealed off for the indefinite future, for it would take almost as large a structure elsewhere to house all the radioactivity it contains. But with No. 2, after a final Wigner release has been performed and the decision is taken not to use it again, it will be possible to use it for certain experiments and valuable parts would be removed.

Thus it appears that while Pile No. 1 will remain in the words of Sir Christopher Hinton 'a monument to our ignorance', pile No. 2 will house experimental laboratories, etc., and lest anyone considers that Windscale is finished, we have Mr. Davey's statement that 'Windscale as a project is not finished. It is only beginning. The reactors have only been a small part of the Windscale project. The chemical plants—which already employ 2,500 of the 2,700 people employed at the site—will grow in importance as ever more nuclear power stations are built elsewhere'. 'Windscale is the central and essential point of the whole atomic programme', another Authority member stated.

Another question that the conference cleared up was that of manuals. It will be recalled that the Penney report said that manuals on the Wigner release were lacking. It is now stated that there were adequate and detailed manuals for all sections of Windscale, and that for the Wigner release was as detailed as was possible in the then present knowledge of the release. Studies on the Wigner release were continuing and much more was now known about it.

In view of the emphasis on increased instrumentation, it has been queried whether the AEA had enough technicians and technologists to operate all the extra instrumentation recommended. The answer is that while AEA is always short of technologists on instrumentation they are somewhat better off than in the more specialised subjects. During the past two years an instrument-training department has been started at Windscale. This is not restricted to Windscale needs but serves the authority as a whole. It is now to be expanded.

CORROSION RATES

PREDICTION of corrosion rates for heat exchangers more accurately than by any other test method used in the steel industry is claimed by Carpenter Steel Inc., Reading, Pennsylvania, US. Equipment developed by Carpenter allows simulation of conditions which range from room temperature to 1,000°F and pressures from one-half atmosphere to 2,000 p.s.i.

Known as a Corrosometer, it has a unique device for heating the metal sample. Clamped to a flask, the sample is electrically and externally heated so that the heat is transferred through the sample into the corrodent (any aqueous chemical solution) in the flask. Concentration of the solution is kept constant with a reflex condenser and pressure control within the flask. Corrosion is determined by weight loss to the metal sample.

Reasons advanced by the Carpenter researchers for the accuracy of the test are as follows: the sample is held at a different temperature from the solution. This is stated to represent the actual relationship between the metal walls of the heat exchanger and the corroding solution; and as the sample is exposed only at the surface, edge effects are eliminated.

The test can be applied to all heat exchangers which operate at temperatures between 60°C and 200°C. Such materials as titanium, zirconium, Zircalloy and nickel-base alloys can be tested under the same conditions.

BACK TO POLYTHENE!

NEARLY 200 took part in our 'polythene or polyethylene' poll (see p. 57), of whom 130 voted for 'polythene'. Those who sent their reasons for their choice were more evenly divided. On the whole, however, the case for 'polyethylene' appears to have been more clearly argued.

Mr. V. A. Kinglake, who wins one of our £10 prizes, admirably sums up the views of those who favour 'polythene'. Mr. D. G. Dalton, who wins a half share in the other £10 prize, states clearly the case for 'polyethylene'. His arguments are largely those which two months ago decided CHEMICAL AGE to use this term in preference to 'polythene'.

For 20 years the UK industry has known this material, invented by ICI, who until recently were the only producers, as 'polythene'. Not unnaturally, the newcomers to this field—British Hydrocarbon Chemicals, Shell and Union Carbide—prefer to use 'polyethylene'. ICI, on the other hand, have good reasons for retaining the good-will of 'polythene', a word coined by them and now so well-known in this country.

Strictly speaking, 'polymethylene' is chemically the word to be preferred, in fact all ICI 'polythene' patents refer to 'polymethylene'. It would, however, add to confusion if this were to be used in addition to the existing terms.

Neither side is likely for commercial reasons to give way; in view of this CHEMICAL AGE will in future use the term which is best known in this country—polythene—and which has the aproval of the BSI, the British Plastics Federation and the International Standards Organisation.

POLYTHENE OR POLYETHYLENE POLL

CA Readers Favour Polythene—Prize-winning Letters Published

A DISTINCT preference for 'polythene' as opposed to 'polyethylene' was shown by those who took part in the ballot held by 'Chemical Age' at the Chemical and Petroleum Engineering Exhibition at Olympia. More than 190 votes were cast, 134 in favour of 'polythene' and 58 for 'polyethylene'.

In conjunction with this poll we offered two prizes of £10 each for the best reasons given in support of each word. The £10 prize for 'polythene' was won by Mr. V. A. Kinglake; the £10 prize for 'polyethylene' has been divided between Mr. S. V. Sergeant and Mr. D. G. Dalton, who receive £5 each. This prize was split as both contributions were adjudged of high merit, one for its originality and the other for the excellent reasoning put forward.

These prize-winning contributions are published below together with a selection of other letters and verses submitted by readers in favour of either 'polythene' or 'polyethylene'. Senders of these contributions receive £1 1s each.

£10 Polythene Prize for V. A. Kinglake

SIR, As I understand it, ICI, who invented the material now known to the public as polythene, coined the name 'polythene' as it was easier to pronounce than 'polyethylene'. Until very recently ICI were the sole manufacturers of ethylene polymers in this country, and their term 'polythene', although not a trade name, was generally accepted in the UK.

Within the last two years several companies, all with American associations, have entered the British market and they all describe their materials as 'polyethylene', which is the generally accepted term in the US.

In certain quarters 'polyethylene' has been held to be the correct term for the polymer; some people, in fact, have insisted that it is the only correct term. However, as Dr. Yarsley, in your letter column, and Mr. M. D. Curwen, editor of *Plastics*, have both pointed out, this use of the term 'polyethylene' is not scientifically accurate, and cannot, therefore, be cited as a reason for adopting the term 'polyethylene', if scientific accuracy is the criterion.

It does seem, therefore, that the word 'polythene' could well serve to identify both linear and branched polymers of ethylene as far as this country is concerned. This approach has the sanction of the British Standards Institution and the British Plastics Federation, and the ISO. However, there does not appear to be any logical reason why both terms cannot be common currency in the UK. There is precedent in the terms 'epoxide' and 'epoxy' resins, and in 'nylon' and 'polyamide'. Both terms are clear enough, and those using one term have no difficulty in communication with people who happen to use the other.

Eventually, of course, one or other term may find universal acceptance, and the same is obviously going to be true of 'polythene' and 'polyethylene'. With regard to educating the public, or at least not confusing it, it is probably better to stick to 'polythene'. This is no more inaccurate than 'polyethylene', and it is more widely known in this country.

Yours etc.,
V. A. KINGLAKE.

83a Elizabeth Street,
Eaton Square, London SW1.

D. G. Dalton and S. V. Sergeant Share Polyethylene Prize

SIR, It is useful first to consider why an invented name for the polymer was used in the first place. Was it to disguise the chemical nature of the polymer in wartime or to provide a short and easily pronounceable name or to provide a trade mark?

Only the last two of these reasons can still have force and it must be admitted that polythene is still a more convenient name than polyethylene, but on the other hand, the polymer is often referred to by the trade mark of the manufacturer. For example, by the trade marks Alkathene or Marlex which also are as easy to use as 'polythene'. As a trade mark polythene cannot now be so used since it has become a widely accepted chemical name for the polymer and has lost its ability to distinguish the goods of a particular manufacturer.

Although widely accepted, polythene seems a less attractive name than polyethylene partly because it is not scientific and partly because the use of two chemical names for the same polymer seems likely to cause confusion. With regard to the first reason polyethylene is the name accepted by scientists all over the world and is indeed preferred to its alternative scientific name polymethamer (1). Furthermore, 'polyethylene' has some chemical significance conveyed by the collocation of 'poly' and 'ethylene' and has the advantage of being easily translatable with accuracy. On the other hand, polythene has no such obvious meaning since it contains no reference to a chemical unit or group without which the significance of 'poly' is lost and indeed might refer to other matters not connected with chemistry.

The possibility of confusion is particularly to be avoided since there are various types of the polymer such as the high-pressure and low-pressure type of polymer and the use of two chemical names to cover both types can only make the task of distinguishing one product from another more difficult. Added to this, of course, is the fact that each manufacturer uses his own trade mark in connection with the polymer. Perhaps confusion can be cleared up by explanation, but this takes up time and energy which might be spent in other directions, and do we want to put our salesmen in the position of having to explain that Alkathene *is* polyethylene, or more generally, that polythene is polyethylene?

One can appreciate that ICI would like to retain the original name they gave to their invention but since this achievement is now well known and is recorded in the annals of science and will be commemorated by those who are now accustomed to using the word polythene, retention of the original name seems no longer justified. Should we not be careful to avoid retention of the name polythene purely for sentimental reasons?

The present position appears to be that the use of two chemical names for the same product is undesirable, that in respect of one of these names, polythene, there is no strong reason for its continued use but there are good reasons against its use, and that the other name, polyethylene, is the clear and scientifically accepted name. The rational choice for the name of this polymer is, therefore, polyethylene.

Yours faithfully,
D. G. DALTON.

1 Mead Way,
Bromley, Kent.

REFERENCE

(1) *J. Polymer Science*, 83, 274.

Pro Polyethylene

SIR,

I think the proper appellation, polyethylene,
Is better than truncated polythene.
Why should we always pander to all those who must be brief
And with such shorthand efforts come to grief?
Why, next we'll have for H_3PO_4 and HCl
Such names as 'phosphic', 'hychlic'—What the hell!
I'd rather spend a moment saying 'Polyethylene'
And banish 'Polythene' right from the scene.

S. V. SERGEANT,
Chief Chemist.

The Ruberoid Co. Ltd.,
Brimsdown, Enfield.

These Readers win £1 1s. Each for 'Polythene or Polyethylene' Views

Polysyllabic!

SIR, The present polyphonic (1) polygraphy (2) pertaining to polymeric products has persuaded me to become plutolatric (3).

Both polythene and polyethylene are polysynthetic (4) polysyllables (5) used prolifically by a polyglot (6) of polymorphs (7), and, as polyonymy (8) already exists to some degree in the field of polymerisation, surely the survival of both forms is assured.

Yours aPolygetically,
C. E. ROLAND JONES

48 Galpins Road
Thornton Heath

REFERENCES

All to be found in the Concise Oxford Dictionary: (1) p. 923; (2) p. 923; (3) p. 917; (4) p. 923; (5) p. 924; (6) p. 923; (7) p. 923; (8) p. 923.

Tri-syllabic

SIR, I prefer polythene because:—

1. Polyethylene is an exact and systematic name indicating its preparation by polymerising ethylene.

2. Polythene sounds like a trivial name, a contraction of polyethylene, but is actually an exact and systematic name in its own right because ethene is an alternative name to ethylene.

3. For convenience poly-ethene is shortened to polythene to avoid two separate 'e' sounds together in pronouncing the word.

4. Polythene also has the merit of saving two syllables, cutting down from 5 to 3.

Yours, etc.,
GRAHAM ARNOLD

2 Queen Anne's Gardens
Bush Hill Park, Enfield

'Ethylene Polymerised is Polyethylene'

SIR, I prefer polyethylene—as a nationalist, since by that name British scientific work is not lost on its own in world indices; and as a rationalist, since that is what it is. Isoprene polymerised is polyisoprene, Propylene polymerised is polypropylene; Logic, system, reason, give the answer clearly seen—
Ethylene polymerised is polyethylene.

Yours, etc.,
J. H. BENNITT

Bakelite Ltd.
Tyseley, Birmingham 11

Made-up Word

SIR, Polyethylene conveys to the mind some definite chemical information; the word will survive in scientific writings. Polythene on the other hand is a made-up word which trips readily to the tongue of the unpedantic because it is a good gesturally descriptive word. Sir Richard Paget (1) discovered that 'though a word may have come into use by some other means than instinctive gesture, its original selection and its survival value are largely determined (though unconsciously) by whether the gestures of articulation which produce it are pantomimically appropriate or not'.

Without going into an elaborate description of the meaning of each consonant and vowel in these words, it may be sufficient to say that 'poly' is cognate gesturally with 'ply' and 'thene' with 'thin'; moreover 'poly' is not so stiff as 'ply'. By the same reasoning 'boycott' is cognate with 'picket', but had the gentleman been called Smith, he would not now be remembered. Similarly polyethylene has no hope of popular survival if polythene is freely offered as a substitute.

Yours, etc.,
ROBERT H. S. ROBERTSON

16 Kirklee Road
Glasgow W2

REFERENCE

(1) *This English*, London: Kegan Paul, Trench, Trubner and Co. Ltd. (1935), pp. 88-94.

'ICI's Baby Name'

SIR,

Her lineage is plain and clearly seen
When she is called Miss Polyethylene,
The names of Polystyrene and the rest
Are not so treated as a family jest.
Give her her due, the world does not deny;
And leave her baby name with ICI.

SILLYKATE

As requested, the £1 1s for this contribution has been sent to the RIC Benevolent Fund. (Editor.)

British Name for British Invention

SIR, The interest shown in the choice of a suitable word to describe polymerised ethylene and related products is very stimulating.

I feel that the correct term is polythene rather than polyethylene for three distinct reasons. First, the material is, chemically, not polyethylene although it might be said that in most cases the greater proportion is in fact this material. Polythene, however, as a generic term can include such components as polypropylene, etc. Secondly, in our scientific literature, and especially in literature which the public must use, the simpler the word used without causing ambiguity the better.

Finally, polythene is a British invention and the first name given to it, polythene, is of British origin. Let us keep the flag flying!

Yours, etc.,
M. W. VINCENT

3 The Rise
Finchampstead, Berks

Generic Name

SIR, Apart altogether from the point that polythene is the generic name adopted by the inventors of ethylene polymers, surely it is preferred on the grounds of euphony alone.

I know it is fashionable for the Americans to pride themselves on their choice of the crisp short word. No doubt it is for this reason that their usage differs from English, as for example, below:

American	*English*
automobile	car
elevator	lift
meet up with	meet
check up on	check
transportation	transport
polyethylene	polythene

Let us stick to the English expression.

Yours etc.,
L. M. SMITH

Wainwright Road
Altrincham, Ches.

New Enriched Uranium Reactor Commissioned

THE UK Atomic Energy Authority has commissioned an experimental reactor 'Horace' at the Atomic Weapons Research Establishment, Harwell. It is intended to provide design data for constructing a larger similar reactor which will be completed later this year and called 'Herald'.

The new reactor has enriched uranium as fuel, and light water to slow neutrons down. The large version will be used for research on the properties of fission and even fusion. The UK AEA also says that it will be used for the production of 'special isotopes'.

Simon-Carves to Supply Sulphuric Acid Plant

Simon-Carves Ltd. have received through one of their subsidiary companies, Simon-Carves (Africa) (Pty.) Ltd., Johannesburg, an order approaching £400,000 for a pyrites-burning sulphuric acid plant to produce 120 short tons of acid per day. The plant will be built for the Harmony Gold Mining Co. Ltd. in the Orange Free State, S. Africa.

New OGL Simplifies Import Business

IMPORT licensing arrangements have been simplified with the replacement of the Open General Imports Licence by an Open General Licence which came into effect on 7 July. The main change is that for the relaxation area and Japan, the OGL will list the items for which individual import licences are required instead of those which are free from specific control.

The various general licensing regulations are summarised in the new notice 860 obtainable from the Board of Trade Import Licensing Branch, 43 Marsham Street, London SW1. The notice also explains the provisions of the OGL and lists the chemicals and other goods which cannot be imported without specific licence.

Lithopone Dumping

The Board of Trade is considering an application for the imposition under the Customs Duties (Dumping and Subsidies) Act, 1957, of an anti-dumping duty on lithopone and other pigments or pigment mixtures containing zinc sulphide (but not including luminous pigments) imported from Germany.

Chemical Industry Is Not Sufficiently Safety-Minded

Papers Presented at Birmingham Course

THE general level of safety consciousness in chemical firms is not high, nor is there much awareness among managements of the need for a positive safety policy from the top, although there are notable exceptions in the industry. These views were expressed by process chemists, chemical engineers, supervisors, foremen and chargehands in a recent informal discussion. This preceded a two-day course on safety in the chemical industry organised by the Industrial Safety Centre, Acocks Green, Birmingham, under the direction of Mr. T. Kenny, training officer at the Oldbury works of Albright and Wilson.

Mr. D. Matheson, HM Chemical Inspector of Factories, speaking on inflammable and explosive risks, said that the speed of reaction was an important factor. Materials in solid lumps might be perfectly safe because of the limited surface coming into contact with the air, but when that contact was increased by breaking down the material into fine particles combustion could be very rapid, often reaching explosive level. Similarly with liquids. In vessels, only the surface could react but when the lqiuid was used in a fine spray or mist, explosions could easily occur.

Safety Limits

For every substance there was an upper and lower limit of safety. Those having wide limits like hydrogen (4.5 per cent to 74 per cent by volume in air) acetylene (2.5 per cent to 80 per cent), carbon monoxide (12 per cent to 74 per cent) were dangerous in nearly all circumstances. Liquids like benzene (1.5 per cent to 8 per cent and petrol 1 per cent to 6 per cent) had fairly narrow limits of inflammability but these ranges included the concentrations of vapours given off by these liquids at ordinary atmospheric temperatures. Most inflammable dusts had a lower explosive limit between 0.02 and 0.04 ounces of dust per cubic foot of air. Upper limits for dusts had not been measured with any accuracy but were of no practical importance.

Ignition temperatures had been obtained under certain conditions of test for the following materials: carbon monoxide 1,200°F; hydrogen 1,000°F; benzene 1,000°F; acetylene 900°F; petrol 500°F. Ether was dangerous because of its low ignition temperature of 350°F. Worst of all was carbon bisulphide which could ignite even below 212°F. An unlagged steam pipe was capable of igniting carbon bisulphide vapour.

If even one of a number of factors could be eliminated then explosions could be avoided. It was difficult to eliminate sources of ignition which were numerous and varied; the key factor was to avoid inflammable concentrations. Grinding processes, processes where finely ground materials were used, and abrading and polishing processes where a fine dust was produced incidentally, were the main hazards.

It was sometimes claimed that so much air passed through grinding plants that the dust was kept below inflammable levels. No reliance could be put upon such a claim. The concentration varied with the rate of feed. If the mill stopped while the feed was still on, the dust was bound to pass into its inflammable range.

Since precautions might fail it was necessary, said Mr. Matheson, to take steps to reduce the effects of an explosion. Recent research indicated that hinged flaps were more effective than bursting panels. Such panels could be made dust or gas tight but once they burst the plant was left open and inflammable materials could escape or air enter the plant. A hinged flap or door, on the other hand, could be arranged to close automatically after it had relieved the explosion. Doors and flaps had their drawbacks, however, since to make a good seal they had to be of heavy construction which prevented them relieving the explosion quickly. It had been shown that a metal door could be constructed which had a size-weight ratio which was relatively narrow and which operated at quite low pressures.

Whatever type of relief was used the size in relation to the area to be relieved was important. Experiments had shown that a relief of 5 sq. ft. to every 100 cu. ft. to be relieved should be considered as a standard for most carbonaceous dusts and some gases.

Placing of Reliefs

The placing of reliefs must permit discharge into the open air and if this had to be done by means of ducting 15 ft. was a maximum length. Longer ducts might themselves explode before they had conveyed the flame and blast to the open air. Ducts must be capable of external examination or they might, through being leaky, become choked with dust which could cause secondary explosion.

Liquids in vessels were not in themselves very dangerous, but their readiness to escape from damaged and leaky vessels and the ease with which they gave off inflammable vapour, constituted a hazard. Tanks should be underground or surrounded with a mound; rooms which contained vessels should be made into 'saucers' by means of ramps across doorways. Such 'saucers' should be capable of holding the total volume of all the containers in the room.

Many cleaning operations carried out with petrol or benzene could be equally well done with white spirit which had a flash point of 90°F. As a rough guide it could be reckoned that one gallon of benzene needed 3,000 cu. ft. of air to dilute it below inflammable limits.

Mr. Luxon, H. M. Chemical Inspector of Factories, in his lecture on corrosive and toxic substances said that where dangerous materials had to be used ideally the plant should be fully enclosed, materials moved by pumps, conveyors, elevators or by gravity in pipes or ducts. But in many cases manhandling was unavoidable. Many accidents occurred when taking liquids from carboys. Simple pumps or plastics syphons should be used and carboys mounted on carriers for moving around.

Internal contact arose through the presence of gases, sprays and dusts in the atmosphere. One half of all gassing accidents were caused by carbon monoxide. Gases might be expected or caused by surprise. The latter often arose from contact between materials not in themselves dangerous. Alkaline sulphides meeting acids in drains could give rise to hydrogen sulphide. Spillage of nitric acid on wood shavings or straw might give rise to nitrous fumes.

Expected gases might be encountered by workers outside the plant when it was running normally or inside the plant during maintenance. Escapes could be prevented by damping materials, if dusts; by using enclosed or leak-proof plant; by working the plant with internal pressures below atmospheric pressure; or by using special devices such as thermostatic controls on open degreasers, or steam blown pokeholes on pressure producers.

Fume Cupboards

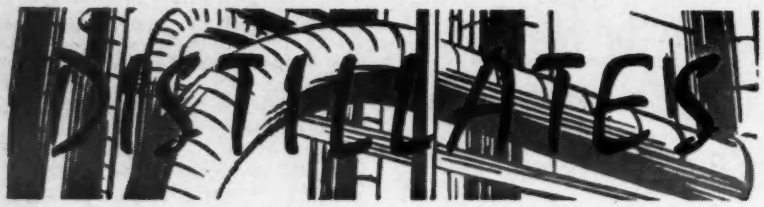
Where escapes could not be prevented, poisons must be trapped by use of fume cupboards arranged so that the worker was outside the danger area or by the use of exhaust hoods. The latter were less efficient than fume cupboards and a higher air velocity was necessary.

The final lecture was given by Mr. B. G. Bromwich, safety officer of Albright and Wilson, who spoke of the organisation for accident prevention in chemical firms.

In considering process work the hazards must be considered in relation to the materials used for the building, the ventilation system, the emergency lighting and escapes. The latter were of great importance and Mr. Bromwich did not consider that vertical ladders were adequate. Emergency escapes must be outside the building and be well constructed. There should be three or four ways of getting out where there was multi-platform working. Spills ended up on the floor and it was often necessary to escape upwards to get into fresh air.

A flow sheet to indicate what was happening in the various vessels should be available to the safety officer so that bursting distances and explosion reliefs could be properly placed.

Where new processes were to be undertaken the text books did not always give the information needed and here the research department could help the safety officer to find out the behaviour of new substances. The medical department could give information about toxicity. This was important because sooner or later a pipe would leak and the safety officer had to know what the possible effect would be. Every process in a chemical plant should be written out in a schedule. Its value to the safety officer was that by using such a schedule he could see what the operator ought to be doing.



★ THIS WEEK I was present at a very pleasant inauguration ceremony—that of the Lead Development Association's offices at 18 Adam Street, London. The association, an advisory body, was formed in 1954 and moved to the new offices last October to allow for expansion. If this expansion carries on at the rate envisaged, another move may have to be made in a few years' time.

At the moment the main outlets for lead production are still cables, sheet and piping, but the association is particularly interested in the demands likely to be made for containers and protective shields by industries dealing with radioactive materials. The present ratio for isotopes to lead protection is 1:10,000. Within a few years it is expected that British nuclear power stations will be producing a yearly average of 13 tons of radioactive waste. The 130,000 tons of lead required to protect this amount of waste would be hard to find and efforts are being made to discover a means of reducing the necessary ratio.

Mixtures of lead and plastics, more malleable than lead alone, still have a protective power, but this is strictly in proportion to the amount of lead used.

★ THE Italian National Chemical Industry Association and the Anic Company (a subsidiary of ENI-AGIP, the State-controlled oil corporation) have been conducting a campaign in the form of full-page advertisements and counter advertisements in some half-a-dozen Italian newspapers, because of Anic's decision to produce vinyl chloride and to sell it to Wacker GmbH, Germany.

It has recently been announced that Anic are to produce 12,000 to 15,000 tons a year of vinyl chloride at their new £50 million petrochemical plant at Ravenna. Following this announcement, the Italian Chemical Association put out advertisements asking whether private enterprise was lacking. These further accused the ENI group of damaging the Italian petrochemical industry by supplying the German industry with a basic material for production of plastics at such a low price as to enable German plastics producers to manufacture at lower prices than anyone else, including those of the Italian market.

I understand that the prices which Wacker will pay for their vinyl chloride imports would be considerably lower than current Italian prices, as the Anic plant will produce vinyl chloride from methane and not from carbide which has been used previously in both Italy and Germany.

Anic's reply to the association was by means of another full-page advertisement stating that ENI-AGIP were supplying methane for chemical use at lire 8.95 per cubic metre—a much lower price than that paid elsewhere in Europe. The advertisement also stated that the methane was being supplied to the Ravenna plant at exactly the same price as that at which it was supplied to any other Italian chemical company. The advertisements and counter-advertisements are continuing.

★ SPEAKING at a recent joint meeting of the National Society for Clean Air and the Royal Meteorological Society, Mr. C. J. Regan, formerly chief chemist of London County Council, stated that the question of pollution by sulphur compounds has probably provoked more controversy than any other. At present pilot-plant scale trials of the Fulham-Simon Carves gas liquor washing process were being made at a Nottingham power station.

Also being investigated (at the Fuel Research Station) is a wet manganese dioxide process in which flue gas passes through a suspension of manganese dioxide in the scrubbing liquor with the formation of manganese sulphate: by electrolysis, sulphuric acid is recovered. Unfortunately this process tends to cool the gases. Other research is being carried out on the possibility of finding a dry process to retain sulphur in the furnace ash by adding, for example, dolomite. Work is continuing on direct absorption of SO_2 from the flue gas by manganese dioxide or alumina-gel impregnated with manganese sulphate and ignited to the oxide/active carbon.

★ A TREMENDOUS advance in what is a relatively new technique—that of gas liquid chromatography—is that of the argon chromatograph introduced by W. G. Pye of Cambridge at the GLC symposium in Amsterdam and shown by them at Achema. Sensitivities some 100,000 times greater than previously attainable are claimed. This ultra-sensitive detector in fact points the way to future developments in this field, particularly as it can be operated by non-specialists.

Pye state that the effect of variables, such as pressure, flow and temperature of both column and detector, are so insignificant that the degree of control is set solely by the column requirements. The detector is essentially a column surrounded by a heater in the end of which is the detector cell. The outlet from the cell is connected to a soap bubble manometer for quick and accurate check of flow rate. A separate bench-mounted cabinet houses the recorder and the amplifier unit (see picture p. 70).

Pye claim that subtle flavours and aromas which have defied analysis will 'yield their secrets; margarine will taste like butter; synthetics will be identical with the real thing'. I am glad to say that CHEMICAL AGE was first with the news of this instrument, thanks to keen-eyed reporters at Amsterdam (CA, 7 June, p. 1025) and Achema (CA, 21 June, p. 1156).

★ A BRITISH pharmaceutical company, formed in 1923 partly with German capital and which still bears the name of Bayer throughout the chemical world, now has no connection with Farbenfabriken Bayer. The complete break which came with the declaration of war in 1939 has never been renewed. In fact Bayer Products are now engaged in setting up their own sales organisation in West Germany.

The trade name of Bayer is still used for sales in the UK market, although exports are handled by the associated export company, Winthrop Products Ltd. It was feared that the dropping of the name Bayer in overseas markets might affect sales, but in fact this has not happened and exports have continued to grow.

In the pre-war days, Bayer Products benefitted from German research in the development of new products. Since the war that work has largely been undertaken by the associated US Sterling-Winthrop Research Institute. The UK company's own laboratories have, however, been responsible for developing a number of new lines.

★ POLYTHENE, polyethylene or polymethylene? Without any sense of shame, or the use of sackcloth or the penitential stool, I hereby renounce my previous decision on this question. I thought I had persuaded my editorial colleagues that 'polyethylene' despite all pressure, was to be preferred.

However, it cannot be denied that that commercially both 'polythene' and 'polyethylene' will be with us for a long time. In view of that, the obvious choice for an independent journal must be 'polythene', the word well-known in this country for so long and which has the support of the BSI and the producers' federation.

One of my colleagues suggested (albeit flippantly) that CA pursue independence and neutrality to its final conclusion—and use 'polymethylene'. Even the pedants would agree that this would take things too far! So unbloody and unbowed, I accept the editorial edict—the polythenes have it.

Alembic

MICROBIOLOGY IN NORTH AMERICA

Industry Contributes 90% of US Spending on Fermentation Research

SUBJECTS included in a Department of Scientific and Industrial Research survey of 'Industrial and Economic Microbiology in North America' carried out between April 1956 and April 1957 include fermentation (food and beverage fermentations excepted), deterioration of materials, water pollution and disposal or utilisation of industrial wastes, and certain other miscellaneous microbial activities of economic significance. The survey, now published as 'Overseas Technical Report No. 4' published by DSIR and obtainable at HMSO, price 2s 6d net, was carried out by Mr. A. W. J. Bufton, a microbiologist on the staff of the Chemical Research Laboratory, Teddington. Many institutions in the US and Canada undertaking research in industrial and economic microbiology were visited.

It is stated that it is difficult to compare the efforts devoted to economic microbiology in Government establishments in the US and the UK. The general impression gained, however, is that in fields of microbial deterioration and of water pollution more work is sponsored by the Government in the US than in the UK. In fermentation, Government-sponsored work in the US is generally limited to the development of uses for agricultural surpluses in contrast to the UK where such surpluses do not occur. More work is sponsored on fermentation by Government in the US than in the UK, but the belief is expressed that if these surpluses were to cease in the US such work would diminish to negligible proportions.

High Value Products

In the US most emphasis in fermentation will probably remain on small-bulk, high value products such as antibiotics, steroids and vitamins which are difficult to synthesise by purely chemical methods. Some renewed interest in the larger-scale fermentations for solvents is considered possible. There also seems to be a considerable development in the study of the causes and prevention of water pollution, particularly by industrial waste.

Fermentation research: In the US this is carried out and sponsored by Federal Government agencies, by industrial concerns, and by universities. During recent years the US Department of Agriculture is estimated to have spent roughly 700 to 800 thousand dollars annually on research in fermentation. Of this total some 500 to 550 thousand dollars were spent on its own research and the remainder on supporting extra-mural research, mainly in educational institutions.

It is estimated that industry contributes 90 per cent or more of the total expenditure on fermentation research in the US. The bulk of it comes from the pharmaceutical and fine chemical companies. The main efforts of the US pharmaceutical industry in recent years have been concentrated on antibiotics both on development of new compounds and on new outlets for existing antibiotics and on steroid hormones. Industrial research on the solvent fermentations is recorded as being virtually non-existent, although fermentation is still responsible for a significant, but diminishing proportion of the industrial solvents produced in the US.

Mr. Bufton reports that production and sales figures for materials produced by fermentation are not easy to obtain since the statistics published annually by the US Tariff Commission do not disclose them in many cases, and do not, in general, differentiate between compounds made by fermentation and by chemical synthesis.

Sales worth $400m.

In 1955, just over 2 million lb. of antibiotics were produced in the US and the sales of more than 1.9 million lb. were valued at $268.5 million. Vitamins B_2 (riboflavine), B_{12} and C, had sales valued at $42 million in 1955. Sales of cortical steroid hormones were valued at $27.5 million in 1955 and have increased substantially since that time. In other categories, the proportion attributable to fermentation is stated to be not so easy to estimate, but with solvents, sales of about $30 to $40 million are likely and sales of organic acids, etc., may amount to $40 million or more. Thus sales of $400 to $450 million are therefore believed to be attributable to products in whose manufacture fermentation has been involved. For comparison, total sales of all synthetic organic chemicals in 1955 were valued at $5,590 million. Fermentation is therefore involved in less than 10 per cent of the market value of the total synthetic organic chemical production in the US. In terms of volume the proportion due to fermentation would be considerably smaller.

Industrial chemicals by fermentation: Statistics of production and sales of synthetic organic chemicals in the US show that in 1955, 27 million lb. of acetone were produced by fermentation, slightly more than 5 per cent of the total production of 539 million lb. in that year. Fermentation butanol is considered to account for a rather larger proportion of the total production of butanol, although separate figures are not available. No glycerol is now being produced industrially by fermentation. Also, although the fermentation process for 2:3-butanediol, intermediate for synthetic rubber production, has been studied intensively on laboratory and pilot-plant scales during and after the World War II, it has not been produced on a commercial scale by fermentation. 2:3-Butanediol is now made from petroleum more cheaply than is possible by fermentation.

Approximately 30 per cent of the industrial ethanol produced in the US during the year ended 30 June 1956 was made by fermentation. Although this still represents a sizeable industry, the indications are that the ethanol fermentation industry is marginal and it is deemed doubtful whether the proportion of fermentation alcohol will be maintained, particularly in view of the high cost of molasses.

Reference is made in this survey to the increase in fermentation alcohol during the fiscal year 1956 due to increased requirements of ethylene for polymer manufacture. Less ethylene was therefore available for synthetic production of ethanol and the deficiency of ethanol was made up from fermentation sources.

Production of glycerol from wood hydrolysates by a continuous fermentation process has been studied in Canada and has been shown to be feasible.

Interest in Ethanol

The appointment of a 10-member group to advise the US President regarding the increased use of agricultural products may lead to a renaissance of interest in the production of ethanol and possibly other solvents. An experimental cost-finding research programme on production of ethanol by fermentation of surplus grain and on conversion of ethanol to butadiene for rubber synthesis has been suggested.

Of organic acids, acetic acid for industrial use is produced entirely by processes other than fermentation. Lactic acid, on the other hand, is produced almost entirely by fermentation from glucose or from starch hydrolysates. Total production of lactic acid in 1955 was over 5 million lb. at an average market price of 37 cents per lb. This price could be reduced if further outlets were developed and production increased. Citric acid is produced almost exclusively by fermentation. Chas. Pfizer and Co., US, are probably the main producers and use the surface fermentation process. Miles Laboratories, Elkhart, Indiana, US, use a submerged fermentation process.

Research by the Division of Applied Biology of the Canadian National Research Council on production of citric acid from sugar-beet molasses by submerged fermentation, using *Aspergillus niger*, both on a laboratory and small pilot-plant scale, had shown that a 70 per cent conversion of sugar carbon to citric acid can be obtained.

Fermentation itaconic acid is produced by Chas. Pfizer and Co.; the relatively high cost (45 to 55 cents/lb.) limits its large-scale application. Esters of itaconic acid (a substituted methacrylic acid) polymerise to give products resembling those derived from methacrylate. This acid might also find applications in the detergent field, where it would compete with maleic and other dicarboxylic acids in manufacture of

wetting agents of the aerosol types. Industrial fermentation processes have been developed for fumaric, gluconic, kojic and oxalic acids.

It is suggested that uses for erythritol, D-arabitol and mannitol, all of which can be produced by fermentation, may be developed as plasticisers or in manufacture of explosives. Industrial companies have exhibited some interest in the fermentation processes for these higher polyols.

Pharmaceuticals: Compounds largely responsible for the high status of fermentation processes in the US today include antibiotics, steroid hormones and certain vitamins. While not strictly pharmaceutical, gibberellin is included under this head.

Most of the larger US pharmaceutical manufacturers are reported as being interested in cortical steroids. There appears to be little likelihood, however, that steroids will displace antibiotics as the chief 'money-spinner' among medicinal chemicals. Of the vitamins, vitamins B_2, B_{12}, C and D_2 are manufactured in part or completely by fermentation.

Gibberellic Acid

Gibberellic acid is being produced using a fermentation technique evolved by Eli Lilly and Co., Merck and Co., and Chas. Pfizer and Co. Because of the agricultural surplus in the US, it is not thought likely that US farmers will exhibit much enthusiasm for materials such as gibberellic acid. Export potentialities seem to be greater.

Enzymes: Microbial production of enzymes has become of increasing importance in the US. Among those known to be produced from micro-organisms are amylases, proleases, pectolytic enzymes, invertase, glucose oxidase and catalase. These are generally marketed as relatively crude dried concentrates of culture liquors.

It seems probable, reports Mr. Bufton, that many further industrial uses for enzymes will be found, leading to considerable expansion of the production of microbial enzymes. Industrial uses of enzymes are primarily in textiles and food processing. Microbial production of enzymes is stated to have considerable potential value and research could improve the range of products and techniques for obtaining them.

Fermentation technology: Fermentation techniques and equipment used in North America do not differ substantially from those used in the UK. Research activity is mainly concerned with the pure-culture submerged and aerated fermentation processes. There is also interest in the development of continuous fermentation. The size of pilot-plant apparatus used in research on fermentation processes has decreased, it is reported, and sometimes 5l. vessels are employed. Industry is interested in increasing automatic control in pure-culture process, but automatic pH control, for example is not generally employed.

Tissue-culture: Culture of higher plant tissue has engaged the interest of Chas. Pfizer and Co. who have patented a technique for the *in vitro* cultivation of plant tissue, (US patent No. 2,747,334). It is considered unlikely that tissue culture of higher plants has been achieved on an industrial scale although the patent quotes two processes, one for the production of oxalic acid, and one for the production of coumarin.

Compounds such as steroid precursors of cortisone and alkaloid, could well be produced more economically in this way than by extraction from intact plants. Tranquillisers are mentioned as being obtainable by this method. There is also the possibility that a new series of antibiotic materials derived from the tissues of higher plants may be discovered.

It is too early to evaluate all the industrial potentialities of tissue-culture, but Mr. Bufton reports that it appears to hold considerable promise as a method for producing naturally-occurring materials which cannot be easily prepared synthetically.

Deterioration of materials: Few of the laboratories in the US or Canada working on this problem concentrate specifically on microbial agents. Much of the work on deterioration in progress in the US, and virtually all the Government-sponsored work, is concerned with its prevention in military equipment. No sizeable research programme is specifically devoted to microbial factors in metallic corrosion in North America.

Water pollution and waste utilisation: Apart from Government work and from co-operation between the Federal Government and industry represented by the National Technical Task Committee on Industrial Wastes, US industry itself, both individually and collectively through various trade associations, is working intensively on waste and effluent problems.

A comprehensive research programme on the problem of synthetic detergents in relation to water and sewage treatment has been sponsored at several academic institutions. Some work has shown that alkyl benzene sulphonates are broken down during sewage treatment but those containing certain structures e.g. alkyl groups containing a quaternary carbon atom, are resistant to bacterial action, and therefore remain unchanged in sewage effluents where they cause foaming.

At the University of Florida one aim o- investigations on the mechanism of anaerobic digestion of organic materials on a laboratory scale, is to discover whether ethane and other higher hydrocarbons are formed during anaerobic digestion.

There is a considerable amount of interest in developing new methods of dealing with industrial effluents. The Zimmermann process, which involves wet combustion of wastes containing organic materials by treatment at high temperatures and pressure, yielding steam as a by-product, is noted as attracting attention, particularly in those industries where the steam could be utilised. Utilisation of organic material in liquid wastes for growth of micro-organisms is only of limited interest.

Miscellaneous microbial problems: Under this head Mr. Bufton has noted microbial metallurgy, the use of bacteria in the release of oil from shale or oil-bearing sands, aid for the recovery of oil, microbial attack on asphalt, and microbial synthesis of rubber.

Nuclear Fuel Processes at Geneva Show

THE United Nations World Conference (1-13 September, at Geneva) will be accompanied by an exhibition on the Peaceful Uses of Atomic Energy with displays from 21 governments. Open from 31 August to 15 September, the exhibition is free to the public part of the time and reserved for conference participants at other periods.

Exhibits on controlled thermonuclear fusion will be shown, as well as reactors to illustrate the process of nuclear fission. Two of these reactors, shown by the US, will be live.

Items dealing with the search for raw materials needed for atomic energy programmes will be presented by many countries. Examples of exhibits in this field are:

France: Separation of U-235 from the more abundant U-238; chemical extraction of plutonium in a remote controlled plant; removal of irradiated fuel from an operating reactor; metallurgy of uranium rods; and methods of prospecting for radioactive ores.

Italy: Functioning model of an uranium fuel plant; instruments and equipment used in basic nuclear research activities.

Norway: Model of the pilot plant for chemical processing of nuclear fuel built at Kjeller.

Sweden: Different stages involved in production of uranium and fuel elements; model of the new 1 billion-electron-volt electron-synchrontron at Lund University.

US: Operating laboratory illustrating health and safety techniques and monitoring live US reactors exhibited; laboratory on radioactive isotopes; special laboratory to demonstrate use of radioactive carbon-14 in labelling and tracing various processes.

10% Increase in DSIR Postgraduate Awards

ABOUT 2,000 students will benefit this autumn when the value of DSIR awards for post-graduate training in science and technology is to be increased by 10 per cent. The increases will apply to both DSIR research studentships (for post-graduate training in methods of research) and DSIR advanced course studentships (for post-graduate courses of instruction other than in research methods).

Students living in college, hostels or lodgings will now receive from £340 to £420 a year according to the university, instead of from £310 to £380. For students living at home the range is now £270 to £285.

The present scale for DSIR research fellowships (for young investigators already trained in research) is also altered: the minimum will now be £700 (previously £600) and the maximum £850 (£800).

Winthrop Laboratories New £2 million Plant Now in Full Production

REACTIONS that can be carried out in the chemicals plant of the new £2 million Fawdon, Newcastle-on-Tyne factory of Winthrop Laboratories Ltd., total between 60 and 70. Many of them represent processes unique to the company. This factory opened last year and now, working to full capacity, produces a wide range of pharmaceutical chemicals for Bayer Products Ltd., and the associated export company, Winthrop Products Ltd.

In addition Bayer Products share manufacturing site facilities with Scott and Turner Ltd. (Andrews liver salts) and the Chas. W. Phillips Chemical Co. Ltd. (milk of magnesia). This association achieves maximum efficiency in manufacture by the sharing of essential services; the policy and administration of Bayer Products is quite separate from that of the other companies.

The two main producing units, inspected by a CHEMICAL AGE staff reporter last week, are the chemicals plant and the pharmaceuticals factory; between them they cover nearly 250,000 sq. ft. This ultra-modern plant uses the 'radio-paging' system to contact executives when they are wanted urgently. Special receivers that clip into the pocket emit a high pitched buzz when there is a message for the wearer.

Two Main Sections

The chemicals plant is divided into two main sections, 'intermediates' and 'fines'. Many preparations have the same intermediate product at some stage in their synthesis and the maintenance of stocks of 'intermediates' enables the speedy manufacture of products at short notice by the fines section. Production techniques are highly specialised and allow for the rigorous control of both composition and purity. A number of the glass- or stainless steel-lined reaction vessels are multipurpose and can be automatically fed with a range of raw materials and services. Other units are more specialised, such as hydrogenation and an iodination unit for the production of the X-ray contrast media Hypaque and Telepaque.

Other preparations marketed by Bayer Products also contain highly specialised active ingredients for which they have devised their own, often unique, manufacturing processes. These include Neophryn, Levophed, Panadol, Pipanol, Monodral, Thenfadil and Veripaque.

The chemicals plant also includes a pilot plant. The central process development and control laboratories are housed in the pharmaceuticals factory and four process control laboratories are sited in the various manufacturing areas, including the chemicals plant.

The necessary control techniques have resulted in Fergon, the Bayer brand of ferrous gluconate, being produced in a special building. Of particular importance is the proportion of ferric iron present in the final product, for which a maximum of one per cent. is recommended. Fergon is prepared to comply with a higher standard and never contains more than 0.375 per cent.

Compounding and packing is carried out in the pharmaceuticals factory. This was designed and laid out after careful planning by a works study team. The tablet section can granulate and compress about 65 million tablets a month. Programmes are arranged so that the production of a batch takes a month, 14 days being allowed for the tablets to pass through the control laboratory before packing can take place. Stocks of tablets, both controlled and waiting for control, are kept in four separate stores.

Each manufacturing order is initiated by the manufacturing instruction, which is a photostat copy of the master formula and shows exact details of the amount of each ingredient to be used, its batch number and detailed manufacturing instructions. Two of the granulation rooms are for toxic material, such as Luminal, and two for non-toxic materials, such as Panadol.

The tablet maker sees that each machine is correctly set to produce tablets of uniform weight, thickness and appearance which will disintegrate satisfactorily and not break up when being handled, filled or transported. Tabletting machines have outputs ranging from 20,000 to 75,000 tablets an hour.

Beeswax-lined tablet polishing pans take about 100,000 tablets each and the complete coating process takes about 14 hours.

After the tablets have been passed by the control laboratories they are automatically packed. The main machines used are the Russell vibrator and the King electronic counter which counts up to 1,800 tablets per minute. It can be set to count any number between five and 1,000 into any given container. The department also packs tablets in a variety of cellulose and other films.

The ampoule department maintains the highest standards of cleanliness, with constantly regulated temperature and controlled humidity. Sterile solutions are prepared in the compounding section, using borosilicate flasks or glass-enamel lined tanks. Refrigerated brine is circulated to maintain products at low temperature and prevent the growth of organisms between the time of manufacture and filling. Freshly distilled water is fed by gravity from Manesty stills. Solid ingredients are dissolved in a high-speed stainless steel mixer and after adjustment of pH are passed through Sparkler horizontal plate filters. Solutions are not re-passed to the filling section until the control department has issued a certificate of release.

Filling is carried out in the sterile area, ampoules being filled on automatic filling and sealing machines that operate at speeds of about 1,500 per hour. Dental cartridges are filled on hand-operated vacuum machines at a rate of about 2,000 an hour.

The Newcastle unit maintains close association with the Bayer Biological Institute at Exning, Suffolk, where vaccines and sera are made. The organisation also benefits in the development of new drugs by its international connections and, in particular, by work carried out at the Sterling-Winthrop Research Institute at Rensselaer, New York, US. The association with Farbenfabriken Bayer, which started with the formation of Bayer Products in 1923, was completely severed in 1939.

Trials on Plastics in the Tropics

TRIALS carried out in the tropics on celluloid and cellulose nitrate compositions have shown that under all exposure conditions deterioration was greater on the transparent materials than on the opaque material containing zinc oxide.

Ministry of Supply Report No. 7 (HMSO, 1958, price 4s net) indicates that three different formulations of plasticised cellulose nitrate sheet were exposed to base depot, jungle undergrowth, jungle clearing and desert conditions in Nigeria for six months. Throughout the trial, deterioration was greatest under desert conditions, all materials showed yellowing, crazing and the presence of free acid. The opaque material (cellulose nitrate, camphor and zinc oxide) showed much greater resistance and although its weight losses were similar to those of batches 2 and 3 (cellulose nitrate and camphor, and cellulose nitrate, camphor and dibutyl phthalate) its dimensional changes were slightly less. A slightly greater loss of flexibility was noted.

There was no apparent difference in the deterioration of all the transparent materials. Batch 3, containing dibutyl phthalate, supported slightly more fungal growth and showed less loss of flexibility. Fungal growth was confined to specimens exposed in the jungle undergrowth and the jungle clearing, the specimens from the latter site showing the heavier growth.

Drug Industry Rejects Pay Offer

An employers' offer of a 4 per cent pay rise for 25,000 process and auxiliary workers in the drug and fine chemical industry has been rejected by three unions. The position is being referred back for consideration.

Bayer Worker Outlines New Project on Dyeing of Polyester Fibres

A RESEARCH project which had as its aim the exact determination of the relationship between fundamental dyeing properties and physical and chemical laws, was related to the West Riding Branch of the Society of Dyers and Colourists recently by Dr. Oskar Glenz of Farbenfabriken Bayer, Germany, when he spoke on 'Investigations of the processes involved in the dyeing of polyester fibres with disperse dyes'.

In polyester dyeing, one of the most important factors was the rate of the dyeing process, and the rate of dyeing depended primarily on three factors: the diffusion of the dye on to the surface, the adsorption at the surface of the fibre and the diffusion within the fibre.

The diffusion rate, said Dr. Glenz, should be inversely proportional to the particle size of the dye involved. In other words, the rate of diffusion depended on the geometrical relationships between the dye particles and the fibre substance Moreover, it was certain that the more firmly the dye was attached to the substrate or to certain sites in the substrate, the stronger the energetic correlations between the dyestuff and the fibre substance.

Attraction Focus

The same forces which were responsible for the solubility of the dye in the fibre were engaged in such energetic correlations. These may be the attraction forces between permanent and induced dipoles, but they could also be Van der Waals or London forces, and, finally there were the forces which originated from the formation of hydrogen bonds.

Probably the last of these provided the most energy. When one examined the polyester molecule, it became clear that hydrogen bonds were formed only with dyes which could act as hydrogen donors and were therefore capable of partaking in correlations between the carbonyl groups of the fibre.

In the first place it was of interest to know whether there was any grouping in the polyester molecule and for this purpose terephthalic acid dibutylic ester had been produced as a model substance, and as a result of experimental work, the following interesting finding arose: While the dissolving power of formic acid ethyl ester could be calculated by addition from that of acetone it was not possible to calculate that of acetophenone from benzene and acetone. Acetophenone had considerably better dissolving power than one would expect from a calculation based on acetone and benzene. This must be due to the correlation of the benzene nucleus and the carbonyl function, which caused particularly high polarisability. However, as this configuration was present also in the model ester and in the fibre substance, it might therefore be assumed that the centres which fixed the dye should be looked for in the COC_6H_4CO grouping, on the one hand because of the easy polarisability of this system in the presence of a dipole, and on the other hand because of the ability of this grouping to form bonds with hydrogen donors.

In order to determine the influence of the dye structure on the rate of diffusion, diffusion measurements had to be carried out on a large number of dyes. In order to retain a clear picture, two groups of dyes were considered only for the purpose of the lecture: those whose diffusion was very much retarded by energetic factors, and dyes which took part in only slight energetic correlations. The much retarded dyes included products with hydroxy groups, which could easily form hydrogen bonds with the carbonyl group of terephthalic ester. These were primarily such hydroxy groups as formed no intermolecular hydrogen bonds and which were sterically capable of reaching the carbonyl group of the ester.

At first Dr. Glenz and his colleagues were astounded to find that other dyes with a free hydroxy group were by no means markedly retarded by energetic factors, and diffused to an extent which could be deduced almost exclusively from their size, i.e. from geometrical factors. This was the case although the hydroxy group could not be engaged by intramolecular hydrogen bonds. An explanation was that it was not directly possible for a hydroxy group rigidly situated at the end of a straight molecule to approach the carbonyl group close enough to enable hydrogen bonds to be formed.

Consideration was then given to those dye molecules which took part in only slight energetic correlations with the fibre and whose rate of diffusion was therefore governed almost entirely by the molecule size.

In this connection the most important substances were some of the anthraquinone dyes. From tests it was observed that the dipole moment of a dye molecule could not be substantially responsible for the fibre/dye attachment forces, because dyes with a similar dipole moment and a not very different constitution, showed a very different diffusion power.

'We therefore assume that the diffusion coefficients are influenced not by the dipole moments of the whole molecule but by certain partial moments of molecule parts, which are identical with the total moment only in special cases', said Dr. Glenz. Examples of diffusion retardation caused by dipole forces were provided above all, by the anthraquinones containing halogen.

In Parliament

Underground Gasification Work to Continue

It is still too early to say if the underground gasification experiment at Newman Spinney will be a success and if a commercial power station will be built. This was stated in the House on Monday by Mr. R. Maudling, Paymaster-General. The National Coal Board believed that it was worth going ahead with the experiment and he thought the Government should support it in that.

Owing to lack of funds and scientific manpower it had not been possible to undertake field trials or fundamental research, since the Zuckerman Working Party's Third Report, on the effects upon wild life of chemicals used in agriculture. This was stated by Mr. J. B. Godber, Parliamentary Secretary to the Ministry of Agriculture, in reply to a question from Colonel T. Beamish concerning reports on this subject from the US and Germany.

The Nature Conservancy, said Mr. Godber, was not aware of any up-to-date evidence from this country to prove that such chemicals were causing important reductions in bird or mammal populations. The Interdepartmental Advisory Committee on Poisonous Substances used in Agriculture and Food Storage kept a general oversight regarding agricultural chemicals and the committee had to be satisfied as far as reasonably possible before making recommendations to ensure the safety in use of chemical products. Mr. Godber added that should evidence of harmful effects be available, he would be glad to receive properly documented cases.

Speedy Condensation Reduces Condenser Size

The Parliamentary Secretary to the Ministry of Works (Mr. H. Nicholls) stated in the House of Commons last week that research, sponsored by the DSIR Mechanical Engineering Research Laboratory, had for some years been carried out by universities on heat transfer under various conditions of steam condensation. It had been demonstrated that the condensation of steam on cooling surfaces as separate drops had great advantages in speed over the normal film condensation. Chemicals had been developed which when applied to brass or copper surfaces would produce 'drop' condensation. Mr. Nicholls said that if the methods proved really succesful, condensers would need to be only half their present size.

ISO Synthetic Rubber Plant on Stream This Summer

The new plant at Fawley of the International Synthetic Rubber Co. comes into operational large-scale production this summer and from 1 September commercial quantities of straight and oil-extended GR-S will be available to all consumers, both at home and overseas, 'at competitive prices'.

Instrumentation Review

POPULARITY OF 'SELECTED PERIOD' POLAROGRAPHY

ACHEMA 1958 will be remembered by polarographers not only because the number of polarographs exhibited reached the record total of 11, but also because each of the eight organisations displaying the new models became a focal point for polarographers of all nations, thus permitting the interchange of ideas and the exchange of experiences, particularly on industrial process control, for which the polarographic method of continuous analysis is rapidly gaining popularity.

The adoption of the polarographic method of analysis in medical research in Germany, exemplified by its use for determining oxygen in the aqueous humour, and the rate of oxygen absorption by the eye lens, reflects the remarkable progress being made both in Germany and Britain in the development of new techniques for medical applications, which in the case quoted may assist materially in diagnosing the causes of cataract.

Paper on Polarography

Of the formal papers presented to the congress, only one was devoted exclusively to polarography, and this paper was presented by a British representative, Mr. J. Hetman of Southern Instruments Computer Division, Camberley, England. At Achema this year the most sensitive polarograph exhibited was undoubtedly the cathode-ray polarograph that is produced by Southern Instruments. This company displayed the latest models of this popular instrument, which was originally developed by J. E. B. Randles, and later by H. M. Davis, G. F. Reynolds and J. E. Seaborn at the Chemical Inspectorate, Woolwich Arsenal (Ministry of Supply), the work being initiated by Mr. A. S. Nickelson in 1943.

Randles derived the theoretical current-voltage relationship for the cathode-ray polarograph, and Davis and Seaborn transformed the research instrument which Randles and Airey had constructed, into a reliable routine analytical tool which, since 1954, has been produced commercially by Southern Instruments.

At Achema 1958 the increasing popularity of the cathode-ray polarograph was clearly revealed by the presence of a new instrument made in Italy. The prototype was produced by Professor G. Semerano at the Polarographic Research Institute, Padua, primarily for kinetic studies and therefore possesses many variable parameters, such as variable delay and sweep periods. These and other parameters have been fixed in the design of the British instrument in order to simplify operation in analytical applications, and in addition permit a sensitivity approximately four times that of the Italian model, although the latter is of larger overall size and is of necessity a floor-standing instrument. The well-known polarographer, Dr. E. Vianello, attended the Italian stand during part of the exhibition, and revealed that arrangements had been made for the commercial production in Italy of the instrument demonstrated.

Polarography at Achema

by W. J. Parker

In this article the polarographic instruments exhibited at Achema are reviewed. Organisations represented were: Radiometer, Denmark; AOIP, France; Atlas Werke, AG, Germany; Southern Instruments Computer Division, UK; Polarographic Research Institute, Padua, Italy; LKB Producter, Sweden; Metrohm AG, Switzerland; Sargent E.H., US.

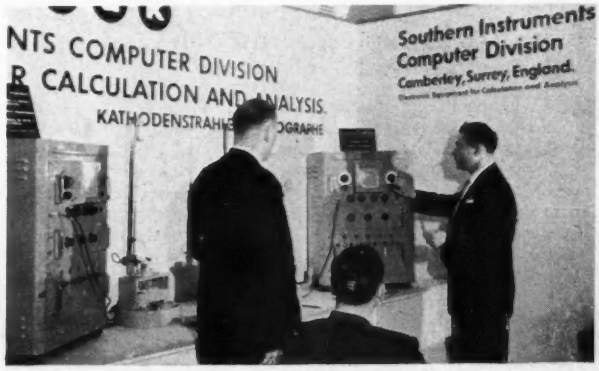
Southern Instruments also showed their anodic attachment which facilitates the production of anodic polarograms with the UK cathode-ray polarograph.

An electrode stand with built-in thermostatically controlled constant-temperature water bath was exhibited by Southern Instruments, whereas the electrode stands produced by Atlas-Werke and Radiometer were designed for use with an external water bath. A notable feature of the Atlas-Werke and Radiometer cell stands was the inclusion of a vertical mercury manometer tube and scale, permitting the direct and accurate measurement of the mercury head applied to the dropping mercury electrode. Other common features included a needle valve, incorporated in the cell stand for control of the rate of flow of deoxygenating gases. The Southern Instruments stand has 3 valves, permitting simultaneous deoxygenation of 3 cells. Clamps for the electrode, reference cell and degassing units, but excluding the cell, are also separate fittings on the German and Danish instruments. The Radiometer stand contains a cell similar to a boiling tube, which is fitted on to the underside of a rubber stopper. The Atlas-Werke stand employs a similar cell but of wider bore, approaching two inches diameter, and having a ground glass cone which fits into an elaborate composite electrode head, with multiple small ground-glass sockets for the two electrodes, de-aerating tube etc. A powerful clip retains the cell in position on the cone. This company also produces a standard rotating platinum electrode and stand unit, for use at higher oxidation potentials.

Large Mercury Reservoir

The electrode and cell stand exhibited by the Metrohm Company retained a simple retort-stand type frame and clamps, with a larger-than-normal mercury reservoir, having a capacity approaching two hundred millilitres. A draw-off tube was conveniently fitted to the underside of this reservoir. The flexible connecting tube contained a stop-cock at the mid-point, a device which eliminates the necessity for lowering the reservoir to stop the flow of mercury. The cell unit, a magnificent creation, consits of a large cell similar to the Atlas-Werke design but having in addition upper and lower draw-off tubes for mercury and solution. The cell is connected by a large ground glass cone to a massive cell-head, mushroom-shaped, and containing no less than five smaller ground-glass sockets on its upper surface, serving the dropping electrode, reference electrode, gas entry, gas exit, and solution entry functions. The cell is retained by spring clips, and supplementary conversion sets are available with rotating platinum electrodes and ancillary equipment for amperometric titrations.

A film, with commentary, showing the production, testing and uses of the Metrohm polarographic equipment was exhibited daily in the Achema film theatre; a valuable feature of this film was the vivid portrayal in colour of the many stages in a complex analysis by so-called



British cathode-ray polarographs exhibited at Achema, on the stand of Southern Instruments Computer Division

Metrohm Polarecord E.261

'wet' methods, involving the majority of the experimental operations under this heading, followed by the same analysis using the polarographic procedure. The elegance of the latter process was admirably demonstrated, and no doubt similar films would be of great value to British polarograph manufacturers. Such films might also be useful for the instruction of customer's staff in the operation of polarographic equipment.

The Metrohm Company produce a simple polarqmeter, having a galvanometer scale one foot long with a maximum full-scale sensitivity of 0.9×10^{-6} A. Counter current and compensation current controls are provided, but no provision is made for motorising the potentiometer as in the UK Cambridge general purpose polarograph and the Tinsley polarograph minor. Furthermore, although the step-by-step adjustment of voltage, featured on the British Electrochemical Laboratories manual polarograph, facilitates rapid operation of this type of instrument the Metrohm still retains a 10-turn potentiometer. The other instrument made by this company, the polarograph bearing the title 'Metrohm Polarecord E.261,' is a pen-recording instrument having a ten-inch width chart, which may be a rectangular card, or a continuous roll. The sensitivity ranges are 1×10^{-10} to 2×10^{-6} A. per mm. in 14 steps. Potential scans are variable, with recorder speeds of 15 or 30 mm. per minute.

'Selected Period' Method

The Atlas-Werke polarograph is of special interest since it incorporates the 'selected period' method[2] for reducing the influence of the charging current. This method is well known in Britain since the Southern Instruments cathode-ray polarograph utilises this principle in applying the potential scan only during the later period in the life of the mercury drop, when the surface area has attained a minimum rate of growth and hence permits the passage of only a minute charging or condenser current. In this instrument a drop time of 7 seconds enables a 5-second period of drop growth to pass, before a 2-second potential scan is applied. Similarly the Mervyn-Harwell square-wave polarograph permits a 2.5-second period of drop growth to elapse before a potential scan having values between 2 and 32 millivolts is superimposed on the steadily-growing d.c. potential. This principle is now applied to a standard d.c. type polarograph. In the Atlas-Werke model, the current is measured only during the short time interval prior to the fall of the mercury drop, and simultaneously the cell-voltage is changed by a value between 10 and 20 millivolts, and the chart paper is advanced only during this period. The resulting polarograms, pen-recorded on a continuous eight-inch chart, exhibit drop-growth oscillations of very small amplitude thus permitting improved resolution and greater sensitivity. A drop time indicator light is operated by the usual impedance-change effect, and the instrument is unique for incorporating no less than ten push-button controls for all the operating variables, apart from damping, sensitivity, selected-period and recorder.

The Radiometer Co. have now introduced an improved instrument, Type PO4, although the earlier polarograph PO3, is still available. These instruments are pen-recording polarographs of traditional design, the PO3 having a cylindrical chart, and the PO4 a continuous strip chart recorder, of chart width 250 mm, together with a derivative circuit similar to the British Tinsley polarograph, mark 19. An interesting facility is the ability to record if required the peak current alone during the life of each drop. This device, coupled with the claim to record undamped polarograms, would have the advantage of permitting the combination of low distortion, obtained in undamped polarograms, with the clarity of damped polarograms.

A polaroscope designed specifically for amperometric titrations was displayed, having a galvanometer scale of 200 mm. and manufactured by Association des Ouvriers en Instruments de Precision. The traditional-type pen-recording polarographs manufactured by the LKB-Produkter Organisation and E. H. Sargent and Co., both having 10-inch width continuous chart recorders, were also exhibited. There was no foreign equivalent of the Cambridge Univector unit however which in Britain is widely used for improving sensitivity and resolution. It is of interest that production of the German Leybold polarograph has now been discontinued. The polarograph exhibitors were visited by many of the world authorities on polarography, including Professor M. Von Stackelberg, Institut für Physikalische Chemie der Universität Bonn; Dr. Otto Hockwin, Universitats-Augenklinik Bonn, and Professor G. Semerano, Polarographic Research Institute, Padua.

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(2) *Elec ronic Eng.*, 1953. 25, 314.
(3) *Polarographische Berichte*, 1957, October, 62-79.

Tin Zirconium Alloy Developed by Battelle for Atomic Fuel Elements

THE discovery that additions of small amounts of tin not only strengthen zirconium but also reduce the variable effect of impurities and have a favourable effect on corrosion resistance, is dealt with by W. Chubb of the Battelle Memorial Institute, Columbus, Ohio, in the quarterly journal of the Tin Research Institute, *Tin and its uses* (Summer 1958, No. 43, p. 18).

Chubb notes that zirconium metal, although currently very expensive, has unique properties that are useful in atomic reactor technology. Strong as steel, corrosion resistant in hot water and exceptionally transparent to neutrons, the commercially pure metal is very much affected by minor impurities. Since the amounts of the minor impurities tend to vary considerably, the properties of zirconium tend to be inconsistent.

Two US prototype atomic power plants both employ tin as an alloying element in their nuclear reactors. A family of alloys of zirconium, the Zircalloys, contain from 0.5 to 5 per cent tin. Zircalloy 2 with 1.5 per cent tin is used as the cladding material for the fuel elements in both an experimental boiling water reactor and the pressurised water reactor. The case of zirconium-tin alloy completely encloses the uranium fuel, supports it and protects it from the corrosive attack of the hot water. Neither of these reactors could operate efficiently, it is disclosed, if any other material were to be substituted for the zirconium-tin alloy.

Consumption of tin in Zircalloys is, at present, no more than a few hundred pounds annually, but it is expected that the rate of tin consumption for new power reactors will increase appreciably if this type of water-cooled reactor proves successful.

This issue of *Tin and its Uses* also contains the paper on 'Organic tin compound as a crop fungicide' by Dr. K. Härtel, Farbwerke Hoechst AG., which he read to the TRI Conference on Organotin Compounds, held in November 1957 in Frankfurt, Germany. The tin preparation in question is Brestan, which is based on triphenyltin acetate (known during trials as VP 19-40). It is claimed to be an effective fungicide against *Cercospora beticola* in beets and *Phytophthora infestans* in potatoes in quantities of 1.8 kg. per hectare (as a 0.3 per cent. spray).

CS Research Fund Grants

Applications for grants from the research fund of the Chemical Society, for research in all branches of chemistry, are now being invited. About £700 per year is available for this purpose and the closing date for applications is 14 November, 1958. Applications from fellows will receive prior consideration. The appropriate forms and regulations may be obtained from the general secretary, the Chemical Society, Burlington House, Piccadilly, London W1.

Overseas News

UNION CARBIDE DELAY CONSTRUCTION PLANS FOR ETHYLENE OXIDE AND ETHANOL

PLANS of Union Carbide Chemicals Co., US, to expand production of ethylene oxide and ethanol have been revised. One of the major reasons for this action is that recent process developments have substantially increased the output capacity of Carbide's existing plants to produce both these chemicals. Another principal factor influencing this decision is a recent re-evaluation of future market estimates, both domestic and overseas, which call for some revision of the anticipated demand for these products over the next several years.

The petrochemical project that Carbide last year announced would be constructed in Putnam, West Va., will be most directly affected by the change in plans. It was originally scheduled to be completed early in 1960. The target date has been deferred, engineering designs are being restudied, and production and feedstock economics are being reappraised. The company stated that it is too early to predict the final outcome of these studies, it is indicated that construction delay will be two to three years.

Although details of the process developments were not revealed, the company reported that they embraced significant modifications in reaction conditions and engineering innovations. As a result of these technological advances, the firm's ethylene oxide capacity has already been raised by 60 million lb. a year. These process improvements are already in full-scale operation in Carbide's domestic plants and will be utilised in the ethylene oxide units now being built in Puerto Rico and the UK by affiliated companies.

Throughput capacity of Carbide's Texas City ethanol plant has also been substantially increased recently, total ethanol capacity having been raised by 20 million gall. a year.

Although the process improvements were a significant factor in reaching the decision to defer expansion of facilities for oxide and alcohol production, the company also said that current business conditions have slowed consumer demand. Forecasts, based on its continuing market studies, indicate a probable lag of about a year in resumption of the characteristic growth rate curve. Moreover, when the Puerto Rico and British ethylene oxide units come on stream this autumn, their output will go mainly to foreign markets which hitherto have been supplied by Carbide's US operations.

Russia Plans to Increase Fertiliser Production

To Mr. Khruschev's chemical expansion programme is now added the Soviet fertiliser industry. Present volume of production of 12½ million tons annually—more than six times the 1945 output—urgently requires to be raised still further.

Russia's fertiliser industry is almost a post-war effort since many of the pre-war mineral fertiliser plants were destroyed during World War II.

An increased demand for fertilisers is expected following liberalisation of Russia's collective farm policy, when a uniform standard price for fertilisers is to be introduced. The collective farms now become the main fertiliser buyers whereas previously, because of the high prices, only state farms could obtain mineral fertilisers.

With the heavy chemical expansion programme on hand, it is considered likely that the USSR will attempt to secure the necessary fertiliser plant in Western markets.

Japanese Methanol Plant Uses Natural Gas

Toyo Koatsu Industries, Tokyo, has commissioned a methanol plant at Chiba based on natural gas. Capacity is 14,500 tons a year. The gas is obtained from the parent company, Kahto Tennen Gas Co., and Aio Mining Co.

Process and know-how are provided by Montecatini of Italy and Soc. Chimique de la Grande Paroisse. Methane is reacted under pressure with oxygen to form synthesis gas which is then fed to the methanol converters.

The methanol plant is the first of the natural gas-chemical projects of Toyo Koatsu. By the autumn of this year three more plants are expected to be in operation. These are a urea plant of 59,000 tons yearly capacity, an ammonium sulphate plant of 50,000 tons capacity and an acrylonitrile plant of 1,500 tons capacity.

Two More US Companies Join Sulphur Export

Jefferson Lake Sulphur and Duval Sulphur and Potash Co. have joined Sulphur Export Corporation to market their sulphur outside North America. Sulphur Export was formed in May by Freeport Sulphur and Texas Gulf Sulphur under the Webb-Pomerene Act which permits companies within an industry to join in transacting their sales abroad. With the inclusion of the two companies, Sulphur Export now handles overseas sales for all US producers of sulphur mined by the Frasch process.

$60 Million Canadian Gas Project

A gas development programme costing $60 million is planned for the Windfall area of Canada, half-way between Sturgeon Lake and the Pembina oilfields in Alberta. The project depends upon the interested parties, which include Canadian Fina Oil, Hudson's Bay Oil and Gas, and Pan American Oil, obtaining an export market for the gas.

At the end of 1957, net disposable gas reserves in the area were estimated at £545,000 million cubic feet. Proven probable and possible gas reserves, according to the operating group, are placed at £1,600 million cubic feet of gas plus reserves of natural gasoline and other gases.

The project as outlined includes a gas recycling plant to recover liquid hydrocarbons from the Windfall field, a sulphur extraction plant, a gas gathering system covering three fields and a development programme.

German Solvay's Production of PVC

A polyvinyl chloride plant of Deutsche Solvay-Werke GmbH is in operation at Rheinberg/Rhld. This is the seventh p.v.c. plant of the Solvay group. Capacity of the group as a whole is reported to be 100,000 tons a year of p.v.c. The sixth plant was set up in Germany and the others in Belgium, France, Italy, Austria, Spain and Brazil.

Emulsions and suspensions of p.v.c. and mixed polymerisates are marketed under the international trade mark name, Solvic. Manufacturing and process know-how is exchanged between all the various plants and Imperial Chemical Industries Ltd.

The new plant is the first in the further expansion programme for p.v.c. by the Solvay concern.

Aerosol Industry in Finland

Sales of aerosol insecticides in Finland rose from 4,000 units in 1951 to 600,000 units in 1957. Only the containers for some 11 different kinds of aerosol on sale in Finland are manufactured in the country. The production machines, the valves and the propellent gases needed or used in the industry are all imported.

£6m. Yugoslav Nitrate Fertiliser Plant

Work began recently on the nitrate fertiliser plant at Pancevo near Belgrade, which is being built with Russian technical assistance and credits. This year, approximately £6,430,000 is expected to be spent, largely on buildings and on excavating a canal from the Danube and building a wharf.

Kuhlmann's Nitric Acid Process

Some details have now been released by Etablissements Kuhlmann regarding their nitric acid process. The new 200-ton a day plant went on stream just over a year ago.

Two different pressure levels are used and also a novel oxidation-absorption column to achieve product acid strengths of 69 to 70 per cent and overall yields of 97.5 to 97.8 per cent. Catalytic oxidation of ammonia takes place at atmospheric pressure but absorption is effected at about 40 p.s.i. A centrifugal compresor boosts the gases from the converter, after cooling, to absorber pressure. The

dual-pressure operation is stated to capitalise on the higher oxidation yield which is made possible by low pressure, while the economy of higher-pressure absorption is maintained.

An interesting equipment feature is a patented absorption column in which the trays are divided into radial absorption compartments separated by radial oxidation compartments. In this column, the NO liberated when NO_2 is absorbed in water is rapidly re-oxidised in liquid phase. Better than 99 per cent absorption efficiencies are claimed for the new plant.

Phthalic Anhydride Manufacture in Italy

Omnilube SpA, Petrochimica, Naples, Italy, has started construction of a phthalic anhydride plant. This will have a capacity of 3,000 tons a year, based on naphthalene, and is expected to be operating in November this year.

The Omnilube plant will be the eleventh in Italy. Other producers of phthalic anhydride are: Aziende Colori Naz. Affini ACNASA, Cengio, Savona; Aziendi Chimiche Vittorio Barbini SPA, Collefero, near Rome; Carbochimital, Padua; Di Vito, Cassina de' Pecchi, near Milan; Conservazione Legno e Distillerie Catrame Cledca, Padua; Ftalital, Scanzorosciate, near Bergamo; Guiseppe Prada, Distillerie Catrame Asfalti SA, Trient; Soc. Industr. Lavorazione Naftalini ed Asfalti Silna, Padua; and SIR, Luino.

Production capacity of existing producers is about 23,000 tons a year of phthalic anhydride. Production in 1956 was about 21,000 tons. Domestic consumption in 1956 was 13,000 tons and 6,200 tons was available for export.

More Acetaldehyde and Octylalcohol for Japan

Acetaldehyde and octylalcohol capacity is to be expanded by Shin Nippon Chisso Hiryo KK, Osaka, Japan, at its works at Minamata. The present capacity is 400 tons acetaldehyde a month and 600 tons octanol a month, which will be taken up by June 1959.

Octylalcohol is produced by Shin Nippon Chisso Hiryo's own process, which is claimed to give high yields. The company are stated to have licensed the process to a Spanish company.

Nickel Production Curtailed by Inco

Another curtailment in nickel production is being made by the International Nickel Company of Canada, Ltd., effective 14 July. This will reduce the company's production of nickel to a rate of approximately 200 million lb. per year.

An announcement in Copper Cliff says that 'since our last curtailment of production, stocks of unsold nickel in the company and in the hands of the US Government have continued to accumulate and now total about 135 million lb. exclusive of nickel in US Government stockpile and of unconsumed nickel in the inventories of customers. Production is to be reduced, therefore, to a rate more nearly in line with deliveries.'

Nickel production capacity at INCO, Sudbury, is over 300 million lb. per year. Full production can at any time be resumed with a minimum of delay. Curtailment of production does not affect the new nickel project at Thompson in Manitoba, scheduled for completion in 1960 and having a capacity of 75 million lb. per year. Previous curtailments in March and in May 1958 lowered the company's production of nickel to a rate of approximately 250 million lb. per year.

Petrobras to Build Synthetic Rubber Factory ?

The 90,000-barrel oil refinery to be built for Petrobras at Caxias in the State of Rio de Janeiro is expected to cost the equivalent of US $27 million and to save foreign exchange at the rate of about US $40 million per annum. Officials of Petrobras are now visiting Europe in order to discuss the purchase of equipment for this refinery, which should be in operation by the end of 1960. This Brazilian oil monopoly will probably receive the contract for the synthetic rubber factory which is to be established near the projected refinery.

New Butane Unit at Hamburg Refinery

A unit capable of producing up to 23,000 tons a year of high purity normal butane has been commissioned at the British Petroleum Co.'s refinery in Hamburg. The normal butane is used at a chemical works in the Ruhr area for the production of butadiene.

Use of Colouring Substances in Italian Food Industries

A recent Italian Law forbade six of the nineteen artificial colouring substances that hitherto were used in food industries. Furthermore, the use of Blue Patent V has been limited to 40 per cent of compound with yellow dyes permitted, and that only for colouring of liqueurs and mustard.

One of the greatest inconveniences that has been caused by the new law to Italian manufacturers is the impossibility of using the traditional blue paper in wrapping up macaroni, sugar, and salt.

The Associations that are particularly concerned have chemical investigations in hand to find a solution. It is generally believed, however, that amendments to the law in question are likely in the near future.

Japanese Fertiliser Centre For Thailand

A Japanese fertiliser service centre, staffed by three Japanese experts, has been set up in Bangkok to advise on the use of fertilisers in Thailand. It is understood that the centre, which will work in co-operation with the Department of Agriculture in addition to advising private agriculturalists, is sponsored and subsidised by the Japanese Ministry of Trade and Industry and the Japanese Fertiliser Export Promotion Association.

Petrochemical Plant for Iran

The Development and Resources Corporation, of New York, has offered to co-operate with Societa' Montecatini in the first petrochemical plant to be built in Iran. The scheme envisages the production of plastics materials and especially of polyvinyl chloride. The potential of the plant is planned at 9 million lb. a year, and it would start operating early in 1961. This project will help to utilise the great quantities of methane available in Persia which are being wasted at present.

Higher Austrian Chemical Exports

The value of Austria's export of chemicals was last year nearly £26½ million, nearly £22,250,000 in 1956 and £10,520,000 in 1952. The 1956-57 increase in the value of exports was 20.3 per cent. The volume of exports last year was 700,000 tons compared with 530,000 tons in 1956—a 32 per cent increase.

Antidote for Nerve Gas Described

NEW protection against the nerve gas sarin may come from an antidote described at the 6th National Medicinal Chemistry Symposium of the American Chemical Society. The use of PAD (pyridine-2-aldoxime dodeciodide), along with its sister compound PAM (pyridine-2-aldoxime methiodide), has effectively blocked the lethal action of sarin in tests with mice, reported Dr. Irwin B. Wilson, associate professor of biochemistry, College of Physicians and Surgeons, Columbia University.

Sarin can paralyse the muscles which control breathing, or attack the central nervous system by interfering with the body's use of cholinesterase responsible for transmission of nerve impulses.

Even more striking antidotal properties were observed when the compounds were further combined with atropine.

The new antidote represents an extension of research reported two years ago by Dr. Wilson, when it was found that a combination of PAM and atropine enabled animals to survive 20 times the normally lethal dose of sarin. PAM removed the trouble-making phosphorus from the poison and atropine afforded protection to the brain. PAM is soluble in water and works well in preventing nerve gas damage in certain areas of the body. It is useless, however, in the brain, which is composed primarily of fatty materials insoluble in water. The development of PAD resulted from an attempt to modify PAM chemically so that it could be utilised in the brain.

The two compounds also have been used successfully in animals against a number of poisons of the nerve gas type, such as TEPP, DFP, and paraoxon, stated Dr. Wilson.

EQUIPMENT REVIEW

Chemical Plant: Laboratory Apparatus Safety and Anti-Corrosion Products

VARIABLE SPEED CENTRIFUGE

BROADBENTS have produced a new variable speed suspended under-driven centrifuge with a mechanical unloading plough discharging through the basket bottom. The mechanical plough empties the basket quickly, according to the company, and thus reduces the overall time cycle, while the manual labour involved in discharging conventional machines is eliminated. To reduce wear from vibration, the plough is mounted clear of the suspended machine. The discharge chutes open when ploughing speed (usually in the region of 30 r.p.m.) is obtained. A hydraulic drive motor gives 3 speeds for feeding, drying and discharging. Hydraulic pressure is provided by an electric motor and pump which can be separately mounted well away from the machine and the only electrical equipment on the machine itself is a flameproof interlock switch. Very heavy concrete foundations should not be necessary and the centrifuge is suitable for mounting on an upper floor, say the makers, Thomas Broadbent and Sons Ltd., Central Iron Works, Huddersfield.

TWO BARRIER CREAMS

CLAIMED to be an effective protection against skin irritation caused by alkaloids is the new barrier cream, No. 14, produced by Rozalex Ltd., 10 Norfolk Street, Manchester.

This cream was developed by Rozalex to prevent skin irritation suffered by workers in the alkaloid department of a firm of manufacturing chemists, and it was known that one of the causes was methylamphetamine. Because of handling difficulties the use of gloves was impractical.

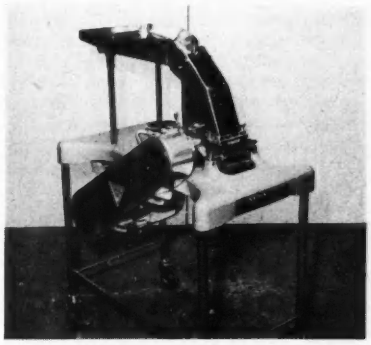
Another barrier cream, No. 15, has been developed for the protection of workers making or handling sex hormones. Despite the use of protective gloves and clothing, masks, enclosed operations, adequate ventilation, compulsory washing at frequent intervals and other precautionary measures, absorption of these hormones through the skin, or by accidental ingestion, had been known to continue.

HEAVY DUTY COMPRESSORS

A RANGE of heavy duty compressors has been introduced by the Consolidated Pneumatic Tool Co. of 232 Dawes Road, London SW6. The range, known as the Class FE, is intended for outputs up to 5,000 c.f.m. at low pressures and lesser outputs up to 3.000 p.s.i. For normal shop use at 100 r.p.m., compressors with outputs from 1,500 c.f.m. to 4,000 c.f.m. can be supplied.

The advantages claimed for the FE class of compressor are high efficiency, small floor area and foundations required, easy accessibility and vibration reduced to a minimum by dynamic balancing. The new design places cylinders with equal reciprocating weights on opposite sides of a frame with pistons driven by a double throw crankshaft and cranks 180° apart. Cranks are arranged in pairs on the shaft and each pair is placed between two main bearings. The construction includes a fully stress-relieved crankcase frame, large crankcase access openings with light-weight aluminium covers and cast Meehanite cross head guide housings.

The crankshaft is a single fully normalised carbon steel forging and carries webs of thick section whilst the precision ground crank pin journals are of the same diameter as the main shaft. The connecting rods are rifle-drilled to permit continuous pressure lubrication. Force-feed lubrication to the bearings, crosshead pin and guides is maintained at a pressure of 40 p.s.i.g. by a positive displacement rotary type pump. A hand-operated lube oil pump for flooding the bearings before starting up is also provided.



New comminuting mill

APEX COMMINUTING MILL

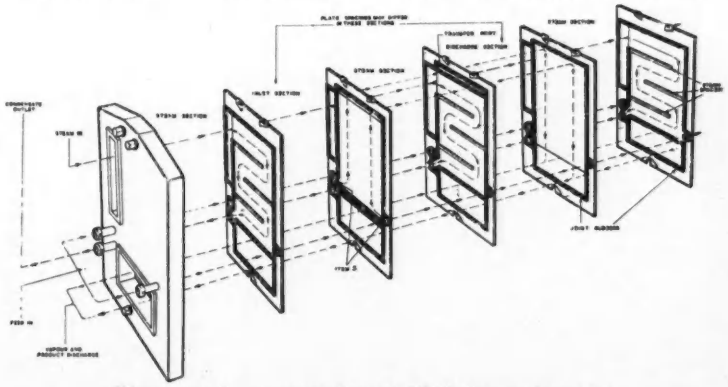
LATEST addition to the range of Apex comminuting mills is the No. 214 model, designed for laboratory, pilot plant and small scale production. This machine is a small scale model of the company's No. 114, but has some new features incorporated. The standard model has its driving motor slung beneath the base which permits greater cleanliness. The grinding chamber has been designed with vertical end plates allowing the mill to be used for granulating stocky materials, and the bearings of the grinding chamber are located outboard of the chamber and have been designed with labyrinth-type grease seals. The makers claim this feature eliminates the use of the rubber tyre grease seal and permits the rotor to be run at higher speeds. Each bearing is also fitted with a grease valve cup for excess or utilised grease. The No. 214 is normally driven by a 3 h.p. motor and speeds up to 7000 r.p.m. are standard. The output of the machine is approximately 100/200 lb./hour. The mill is normally built with blades which have one face hammer for pulverising and the other knife for cutting. The change from knife to hammer edge is carried out by reversing the direction of rotation of the motor.

Some uses suggested are: size reduction, in which coarse down to fine powders in 1-25 micron region can be obtained; wet or dry granulation and intense mixing of both wet and dry products.

APV PLATE EVAPORATOR

FURTHER details of a plate evaporator shown by The APV Co. Ltd., Manor Royal, Crawley, Sussex, at Olympia (see CHEMICAL AGE, June 14 p. 1096) are given below. The evaporator is claimed to be of revolutionary design and operates on the climbing and falling film principle. It uses plates instead of tubes in an arrangement which is basically similar to that of the plate heat exchanger. Tests on a commercial scale prototype installed in a UK dairy have shown that with slight modification most evaporation duties can be carried out.

Advantages of this type of evaporator are said to be: (1) lower prime cost

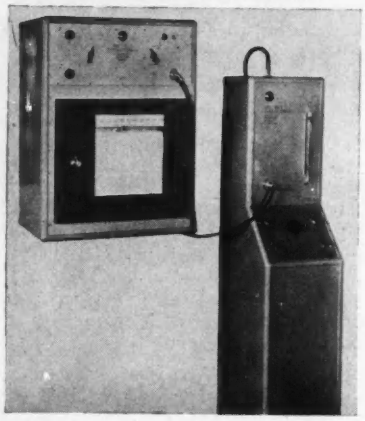


Diagrammatic representation of APV plate evaporator

(2) low overall height, (3) plant is entirely on one level, (4) greater flexibility, (5) plates fully accessible for cleaning or replacement, (6) simple operation, (7) low volumetric capacity of the plant means quicker starting up and shutting down, and also that the liquid is in the evaporator for a short time.

The plate evaporator differs from the conventional unit in that the calandria is replaced by gasketted plates held together in a frame, consisting of fixed and movable clamping members, end support and suspending bar. The platage is built up into units, each comprising a rising film (inlet) section and a falling film (discharge) section, together with adjacent steam passages. The separator is unorthodox since it operates on a horizontal instead of a vertical axis.

NEW ARGON CHROMATOGRAPH

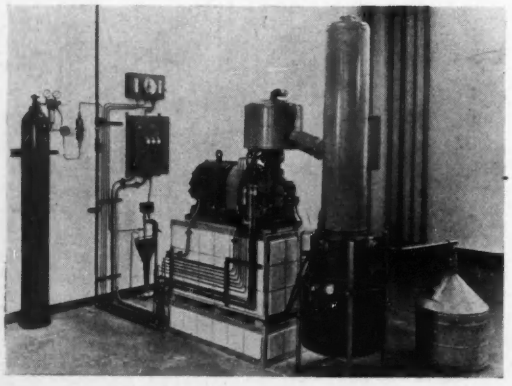


New Argon chromatograph, by W. G. Pye and Co. Ltd., Cambridge, referred to in our report of Achema (21 June, p. 1156), is said to make possible sensitivities 100,000 times greater than previously. Sensitivity range is about 1 part component in 2 x 10^6 to 2 x 10^3 carrier gas (argon) for full scale deflection on the recorder. A micropipette of 0.1 microlitre is provided and other sizes down to 0.025 microlitre can be supplied.

GAS REFRIGERATING MACHINE

AN ADDITION to the range of Philips gas refrigerating machines, is announced by their distributors, Research and Control Instruments Ltd., 207 King's Cross Road, London WC1. This machine (the PW 7050) incorporates a nitrogen separation column, by which means air may be liquefied and separated at atmospheric pressure to produce four litres of liquid nitrogen per hour. Continuous operation is said to be possible for a period of one week before de-frosting becomes necessary.

Special features claimed for the PW 7050 are: fully automatic operation without the need of supervision; small dimensions compared with conventional equipment—the column stands approximately 6 ft. high; negligible contamination risk, because the air is cooled at atmospheric pressure in a single stage and does not pass through any moving parts.



Philips gas refrigerating machine, PW 7050

NEW INSTRUMENTS BY FISHER

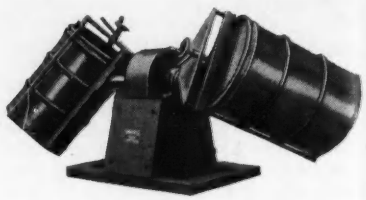
RECENT extensions to the ranges of Fisher Governor Co. Ltd., Maidstone Road, Rochester, Kent, include two types of electro-hydraulic operators and a pressure controller developed from their Wizard 4100U.

The new Fisher type 340 and type 350 electro-hydraulic valve operators are self-contained, electrically operated valve actuators, particularly designed for use in electrical control loops. Electronic amplification is not used, only a simple DC electrical circuit to control the hydraulic pilot. The pilot systems incorporate no close fitting parts, but use nozzle-flapper combinations to control hydraulic pressure. Sizes available have either a maximum stem thrust of 600 lb. (for valve sizes from ½ in. to 4 in.) or of 2,000 lb. (for all valve sizes up to 16 in.).

The Wizard II pressure controller has some improved and new features: a volume relay for faster response to pressure changes; provision for reset, ensuring closer pressure control; wider proportional band with linear output.

CHANGE-DRUM TUMBLER

FOR dry-colour blending and mixing of phenolic materials Winkworth Machinery Ltd., 65 High Street, Staines, Middx., have produced a change-drum tumbler. This machine may be bought with fixed drums for filling and emptying while held in the clamps, or can be used with standard detachable disposable 50-gall. drums. Drum sizes accepted are: maximum drum height 33 in., diameter 28 in. Smaller sizes can be accommodated providing wood blocks are used.



Winkworth tumbler

The motor usually supplied is of 1 h.p., 50 cycles a.c. (unless otherwise ordered) with heavy duty roller chain drive. The tumbler has a capacity of two 200-lb. drums, but the firm will supply a one-drum holder with counterweight.

AUTOMATIC WELDING EQUIPMENT

THE Autopak automatic welding equipment is portable; it can be used as a manual welder, and also can be extended to any fully-automatic application. When not running automatic submerged arc welds it is available for hand welding with ordinary coated electrodes. The automatic arc voltage control equipment is stated by the makers, Rockweld Ltd., Commerce Way, Croydon, Surrey, to be more sensitive than existing methods. There are no electronic components.

An adaptation of the twin motor control system has been adopted for a drive unit for the welding head carriage. This provides a 25 to 1 continuous speed variation. The unit's welding head is designed to take continuous wire feed when powered by the Autopak transformer and is intended mainly for submerged arc welding. Standard head and rolls take up to ¼ in. diameter bare coppered-steel wire.

Price of basic equipment for automatic welding is £645.

GENERAL PURPOSE COUNTER

To provide comprehensive scaling facilities for geiger and scintillation counters used for the assay of alpha, beta and gamma active samples, Airmec Ltd., High Wycombe, Bucks, in conjunction with the UK AERE, have produced Type 1339A equipment. Two main units form the basic equipment, which may be supplemented by accessory sub-units for beta gamma counting to serve alcohol quenched types of counter and most types of halogen quenched counters, or for alpha counting with scintillation type probes.

The power unit provides all power supplies, including stabilised EHT. The scaling unit consists of a slow scaler sub-unit and a paralysis/timing sub-unit. Features include facilities for slow speed scaling, a choice of paralysis times, and an automatic timing control.

Accessory equipments available include a quenching sub-unit for use with geiger counters for beta gamma counting, and an amplifier/discriminator sub-unit for alpha counting with scintillation type probes.

A fast scaler sub-unit may also be obtained where the sample disintegration rate is high.

DOULTON BALL MILL

A RANGE of porcelain-lined ball mills of new design has been introduced by Doulton Industrial Porcelains Ltd., Wilnecote, Tamworth, Staffs. Known as Figure C.401, they are constructed from Doulton

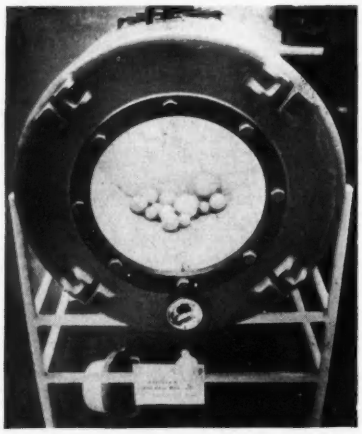


Figure C.401 porcelain ball mill by Doulton Industrial Porcelains

hard porcelain. These mills are said to be free from corrosion and contamination and ideal for wet or dry grinding of paint ingredients and pharmaceutical products. Supplied in ten sizes from one pint to seven gallons nominal capacity, they have a special ground cover and fixing arrangement. A particular feature is that covers are interchangeable without affecting the efficiency of the seal. A pouring spout, which can also be used as a strainer, is available if required.

BUNSEN BURNER FOR NATURAL GAS

AMAL LTD., Holford Works, Perry Barr, Birmingham, have developed a Bunsen burner which will burn propane-butane and methane natural gas mixtures instead of town gas. When lit, the new burner produces a mass of small blue cone-like flames spread out over the surface of the burner head.

The new burner differs from the usual Bunsen burner in a number of features. The design allows the movement of a greater volume of air through the burner than is normally the case with the conventional Bunsen burner. The high calorific values of gases such as propane-butane and methane make this necessary if a similar heat output to that obtained by a burner using town gas is to be obtained.

The company claim that the new burner is fully as efficient in operation as the best-type modern Bunsen burner burning town gas.

Forest Products Laboratory to Concentrate More on Research

WITH the transfer of responsibility for some of the Forest Products Research Laboratory's work to the Timber Development Association early this year, FPRL should have more time available to devote to research that could lay the foundation for new developments. This view is recorded in the annual report, *'Forest Products Research'* 1957, published for the Department of Scientific and Industrial Research by HMSO (price 6s ($1 8 cents US) 6s 5d by post).

Properties of adhesives: Work on long-term durability of glues has continued and has been extended to increase the number of types of adhesives investigated.

A method has been developed for testing the strength of thermoplastic wood adhesives such as polyvinyl acetate (p.v.a.) emulsions. The test sample, consisting of three beech slips 4½ in. x 1 in. x ⅛ in. glued together with the centre component of the joint overlapped by those outside by ¼ in., is laid on two rounded supports 4 in. apart and a central load applied. Testing loads of the order of 300 lb. were obtained with two brands of p.v.a. emulsion. Temperature and moisture content at the time of testing have been found to have a considerable influence on the strength and sustained loading tests; with two p.v.a. used an increase in moisture content of only 3 per cent from 10 per cent was sufficient to cause a considerable reduction in the strength and the time to failure under sustained loading. A controlled atmosphere is essential for testing.

Chemical Investigations: Beech hemicelluloses have received further study. The mixture of uronic and aldobiuronic acids, obtained by acid hydrolysis of alkali-extracted beechwood, has been shown by fractionation of a column of IR4B resin (formate form) to be even more complex than was originally supposed. At least 16 acids were detected.

Attempts have been made to fractionate hemicellulose A through its copper complex, but without success. A further hemicellulose preparation has been isolated from beechwood in a yield of about 2 per cent. This was obtained by addition of ethanol to a N-sodium hydroxide extract from which hemicellulose A had previously been removed by precipitation with acid. The more soluble fraction yielded, on hydrolysis, a mixture of sugars in which xylose predominated, together with a mixture of acidic materials. Water-soluble polysaccharides in beech have been examined. Aqueous extracts, obtained by covering extractive-free beechwood with cold water and leaving three days, were separated and evaporated to small volume and the water-soluble polysaccharide was precipitated by additions of ethanol. Hydrolysis, after the product had been purified by reprecipitation, yielded galactose, glucose, mannose, arabinose, xylose and rhamnose, identified chromatographically. Only one aldobiuronic acid could be detected on the chromatogram in any quantity. This material had a similar R_G value to 2-*O*-(4-*O*-methyl-D-glucopyruronosyl)-D-xylose.

Corrosion of metal by wood: Investigation of the corrosion of cadmium-plated parts by volatile components arising from wood have been extended to include plywood and wood-glue assemblies incorporating a number of different synthetic-resin glues. It has now been established that, in addition to the corrosive effect of some woods, previously reported, volatile components from these glues can also be very corrosive to cadmium plate, particularly under damp conditions.

Two urea/formaldehyde (U/F) glues caused severe corrosion during an 8-week period, while a liquid phenol/formaldehyde (P/F) and a dry film P/F resin produced only slight corrosion. Volatile acidic substances released during the curing and ageing of the glues appeared to be the chief corrosive agents, assisted in some cases by formaldehyde liberated by decomposition of the resin. The extreme variability of the corrosive effect of these glues, all made from the same type of resin, appeared to arise from the different hardening mechanisms favoured by the various makers.

The number of chemical enquiries dealt with by letter was 207, a small increase over previous years. Visitors totalled 55.

Vinyl Licensees on the Thames

Representatives from Vinyl Products Ltd. overseas licensees attended a sales conference at Carshalton, Surrey, recently. Here members of the party are seen aboard a steamer on a trip to Hampton Court

Chemist's Bookshelf

POST-URANIUM ELEMENTS

THE CHEMISTRY OF THE ACTINIDE ELEMENTS. By *J. J. Katz* and *G. T. Seaborg*. Methuen and Co. Ltd., London. John Wiley and Sons, Inc., New York. 1957. Pp. xv + 508. 63*s*.

Less than 20 years ago the Periodic Classification was comfortably limited by hydrogen on the one hand, and by the elements actinium, thorium, protactinium and uranium on the other. Although protactinium had been little studied, these elements were regarded as unusual only in their exhibition of radioactivity. It is true that it was not always possible to link the properties of these elements neatly with those of their presumed congeners in the Periodic Table; and some years earlier theoretical knowledge of the electronic structure of the elements had indicated that there might well be a second series of 'inner-transition' elements, paralleling the 'rare earth' elements and beginning somewhere around element 90. However, in the twenties, it seemed highly unlikely that further research would reveal in the earth's crust elements with atomic number higher than 92. The rapid strides in nuclear bombardment techniques in the thirties brought the possibility of post-uranium elements nearer to reality; and although the first reports of such elements were spurious, they prepared the scientific world for the actual production of the first post-uranium element in 1940.

Fundamental Importance

These post-uranium elements—now 10 in number—provide us with no less than 13 of the 14 'f-level' elements which, together with actinium, comprise the theoretical parallel to the lanthanons. The elements are of fundamental importance, both to the technologist and to the chemist. The book under consideration provides much material of importance for the growing field of nuclear technology. For the chemist, with whom this review is more concerned, it is fortunate that the elements are of such outstanding importance technologically. Without doubt this has augmented greatly the number of workers and the amount of work on the elements since their discovery. In the reverse direction, the technologist requires that the chemist should have the fullest possible practical knowledge of the chemical behaviour of the elements. Theoretical importance of the elements for the chemist is clearly shown by the wealth of information which the last 15 years or so have produced, and which is ably presented here. As is made obvious, both the similarity to and the differences from the lanthanons have much significance, in particular for those workers concerned with clarifying the relationship between electronic structure and chemical behaviour.

The material in the book can hardly be praised too greatly. It is presented clearly, authoritatively, and (not least) interestingly. Its up-to-dateness can be judged by the fact that nobelium, first reported early in 1957, receives mention. The literature references are comprehensive. Each element is dealt with separately, those up to curium, about which knowledge is reasonably extensive, receiving lengthy treatment. In addition, there is a valuable final chapter which considers the group as a whole. Professor Seaborg's interest in correlating the properties of these elements is well-known, and this chapter gives an excellent critical view of the group of actinides. (The reviewer would prefer the term 'actinons,' since 'actinides,' the natural degenerate of 'actinide elements', is not unambiguous.) Not the least interesting part of this chapter is the short speculation on the extent to which we may be able to push yet higher in the periodic classification.

The production of the book is a worthy match for its contents. This is the first comprehensive unified contribution to a relatively new field of inorganic chemistry; and so intrinsically, quite apart from the grounds of general excellence, the book must be rated as an essential reference work for all inorganic chemists.

CECIL L. WILSON.

Analysis of Non-Ferrous Metals

RAPID ANALYSIS OF NONFERROUS METALS AND ALLOYS. By *G. Norwitz*. Chemical Publishing Co. Inc., New York. 1958. Pp. 112. $4.25.

Although this is only a small book there are sixteen chapters comprising ingot copper, brasses and bronzes, Monel and nickel metal, aluminium alloys, magnesium alloys, zinc metal, zinc-base alloys, cadmium, tin, lead, lead-base bearing metal, tin-base bearing metal, lead-tin solders, silver solders, fusible bismuth alloys. It has been possible to cover so much ground in so small a volume because it is in fact a method book. Chapter 1 deals with special reagents, chapter 2, ingot copper, begins: 'Transfer a 3 g. sample to a covered 300 ml. electrolytic beaker and add 35 ml. of nitric acid (1 to 1)'; and the instructions for everything that follows are given similarly in the imperative.

The author claims that there is an increased reliance on sequence procedures; mathematical correction factors are used to eliminate lengthy separations, colorimetric procedures are stressed, increased use is made of perchloric acid. He then seeks to justify the use of sequence procedures, but not everyone will agree that they are necessarily more rapid, neater or more accurate. In the opinion of the reviewer, methods in which correction factors are applied to avoid separations, or the iron determined as in ingot copper (p. 15) by comparing the stain of iron hydroxide on a filter paper with stains obtained from standard solutions, may be rapid but it can hardly be claimed that they are accurate. As many of them require a 50 g. sample it is doubtful if they can be considered modern.

R. C. CHIRNSIDE.

Monograph on Plastics Extrusion

EXTRUSION OF PLASTICS. By *E. G. Fisher*. Published for the Plastics Institute, by Iliffe and Sons Ltd., London. Interscience Publishers Inc., New York. 1958. Pp. 114. 21*s*.

This small book is the first of a series of 10 monographs on plastics technology to be made available to the general public by the Plastics Institute. Engineering monographs are to be published under the editorship of H. Barker and the chemical ones under that of Professor P. D. Ritchie. Such a series, written by experts in each aspect of the industry, will be welcomed after the rapid developments of recent years.

The present volume concerns extrusion. After a brief historical introduction the author indicates the different types of extrusion practised and passes to a description of the theory of the modern single screw extrusion machine. At the time of publication all available extrusion theory deals with processes taking place in such machines, and concerns granular material or the pure melt. In view of the weight given by the author to this theory it is perhaps necessary to emphasise the strongest criticism of it: that it is unlikely that plastics materials are Newtonian—as the theory assumes—at any time during their passage through an extruder.

The multi-screw extrusion machine is then discussed. Theoretical considerations are necessarily briefer, but the comparison with the single-screw extruder is clearly made. The author goes on to describe constructional features of screw extruders; the value of this chapter is enhanced by one on the materials to which the process is commonly applied. The complete extrusion process is finally discussed, the description of the variety of dies and of the separate units constituting extrusion plant giving some indication of the versatility of this important industrial technique. A chapter on the extrusion of thermosetting plastics completes the monograph.

For striking a balance between detailed and general discussion which the industrial student will find both readable and informative the author is to be complimented. The book appears free from printers' errors; good features are clear line drawings and a full index.

J. P. G. FARR

A Modern Approach to Organic Chemistry

J. Packer and J. Vaughan

The emphasis in this book, which covers basic requirements for an initial degree, is given to the correlation of theory with fact. The authors have amassed the knowledge acquired in this field during the last thirty years, and the work may be considered comprehensive. 980 *pages, with numerous text-figures* 84*s. net*

An Introduction to Chemical Thermodynamics

E. F. Caldin

In discussing the laws of thermodynamics, the author has aimed at a balanced account of the experimental evidence, the methods of handling it, and the interpretation of results. University students will find the book useful for undergraduate or graduate course work. 450 *pages with* 80 *text-figures* 50*s. net*

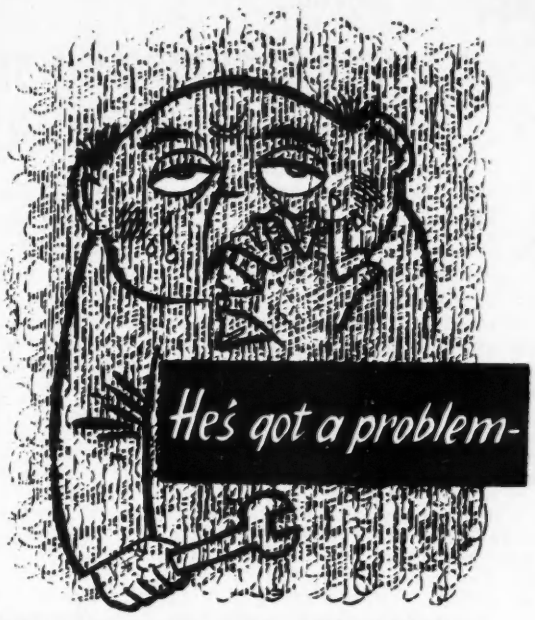
The Chemical Industry during the Nineteenth Century

A STUDY OF THE ECONOMIC ASPECT OF APPLIED CHEMISTRY IN EUROPE AND NORTH AMERICA

L. F. Haber

The author traces from the beginning of the century the historical background and scientific discoveries which shaped the development of chemical manufacture in the various countries and, in particular, examines the influence of these factors on the growth of the British soda industry, the dyestuffs concerns of central Europe, and chemical firms in the U.S.A. He also considers social conditions and the effect of different approaches to scientific education. 304 *pages, with text-figures* 45*s. net*

OXFORD UNIVERSITY PRESS



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CIBA SYMPOSIUM ON MUCOPOLYSACCHARIDES

CHEMISTRY and BIOLOGY of MUCOPOLYSACCHARIDES (Ciba Foundation Symposium.) Edited by *W. E. G. Wolstenholm*. J. & A. Churchill Ltd. London. Pp. 323. Ill. 48. 45*s*.

The text follows the pattern of the earlier Ciba Symposia in containing a number of original papers and the discussions arising from them at the meeting. For the purpose of the symposium the term mucopolysaccharide has been broadly defined as denoting macromolecular carbohydrate- amino acid complexes which cannot as yet be described in exact terms. The first observations on these substances were made in 1846 but it is only in the last 20 years that there has been intensive investigation. The mucopolysaccharides are now known to be widely distributed in the animal and plant kingdoms and are proving to be of great biological importance. Many are of structural function in cell walls, whereas others have much more specialised functions such as the blood group substances. Some mucopolysaccharides have a range of functions; for example, hyaluronic acid probably serves as a lubricant in the joints and tendon sheaths and might have a cementing or transporting function in the connective tissues, while in the eye it is implicated in controlling the movement of the aqueous humour.

Topics covered in the symposium range from the purely chemical ones to those describing studies on the biosynthesis of mucopolysaccharides and their distribution in plants and bacteria. The purely organic and physico-chemical papers deal with attempts to arrive at the structure of some of these substances. One major difficulty has been the purification of these substances which are associated with proteins in the tissues; the neutral mucopolysaccharides appear to be in definite units with the proteins whereas the acid mucopolysaccharides are more loosely associated. So far only gross structures of these compounds are known but immunological approaches and infra-red spectroscopy should prove valuable tools for the future. The connection of the mucopolysaccharides with the blood group substances led to the realisation that many of these substances were under genetic control. It is likely that some inborn metabolic disorders in the mucopolysaccharides result in diseases affecting the connective tissues and perhaps the nervous system. Little is known of the qualitative and quantitative changes in disease, but there is some information about alterations of the mucopolysaccharides in urine and serum.

This book should prove a useful source of references to the mucopolysaccharides. The subject matter is by its nature extremely specialised, but it gives the reader an example of an attack on complex substances of great biological importance by a wide range of scientific approaches.

K. R. REES.

Modern Developments in Emulsions

EMULSIONS. By *P. Becher*. Reinhold Publishing Corporation, New York. 1957. Pp. ix + 382. 100*s*.

The past few years have seen the development of many new emulsifying agents and the increasing use of emulsions in chemical science and technology. Parallel work on surface activity and the physical properties of emulsions has resulted in a better understanding of the principles underlying their formation and stability. This timely book is mainly concerned with modern developments in theory and practice and deals successively with physico-chemical principles, theories of emulsions, emulsifying agents, applications of emulsions and demulsification.

A first chapter on relevant surface and bulk properties of solutions includes a brief account of surface films and a more detailed consideration of solutions of colloidal electrolytes. A discussion in some detail of the physical properties of emulsions includes as topics, drop size and its distribution, emulsion viscosity, interfacial films and some electrical properties of emulsions. As the author points out, no single theory of emulsion formation and stability exists and is not to be expected in view of the diversity of emulsifying agents. Older theories are reviewed briefly and more recent ones, which consider the nature and properties of the interfacial film, are critically discussed at some length. Solid-stabilised emulsions are included and the theories relating to such properties as creaming, inversion and breaking of emulsions.

The remainder of the book is concerned with practical aspects. Emulsifying agents are classified, the chief properties of each class considered and the chemistry of individual agents discussed. Methods of estimating their efficiency are given and estimates tabulated. Techniques of emulsification on the laboratory and plant scale are discussed and apparatus described. A chapter is devoted to emulsions used in such applications as cosmetics, polishes, paints, foods, polymerisation and textiles. Methods of breaking emulsions are also discussed. The book concludes with two useful appendices, the first of which describes the testing of emulsion properties. Methods are given in reasonable detail for the measurement of surface and interfacial tensions, viscosity and electrical properties and the determination of emulsion type, stability and drop size distribution. The second appendix lists commercial emulsifying agents, largely American, and gives their trade names, manufacturers, compositions and indications of their applications.

The production is good with an adequate index and many clear diagrams. An extensive bibliography is given at the end of each chapter. The book provides an up-to-date account of emulsion theory and technology and, although the price is rather high for personal ownership, it should be on the shelves of laboratories or libraries of all organisations concerned with the chemical technology of emulsions in whatever field.

W. R. MOORE

Vogel's Third Volume, Quantitative Analysis

ELEMENTARY PRACTICAL ORGANIC CHEMISTRY. Part III. Quantitative Organic Analysis. By *A. I. Vogel*. Longmans, Green, London. 1958. Pp. xiii + 841. 21*s*.

The first two volumes in this work deal with small-scale preparations and qualitative organic analysis. This new volume, which completes the work, is an authoritative textbook of organic quantitative analysis through the medium of functional groups. In spite of the author's modest claim that it is not all-embracing, it nevertheless contains a large amount of most valuable material.

Included in the first chapter is the semi-micro estimation of nitrogen by the Dumas and the Kjeldahl methods, and of halogens by a modified Stepanow method.

The wide range of estimations described includes alcoholic OH groups by phthalation with phthalic anhydride in pyridine, and adjacent OH groups (as in polyhydric alcohols) by the Malaprode reaction; amino groups and amino acids; carboxyl groups and esters; aldehydes and ketones; enols and imides.

Each set of determination is preceded by a masterly discussion of the underlying physico-chemical principles involved. As already noted in the two previous volumes, practical instructions in this new one are models of clarity and precision.

Many interesting modern methods are employed, including titration in non-aqueous media, the use of ion-exchange resins, and the Karl Fischer reagent; the morpholine reaction for the determination of the anhydrides of organic acids; the hydrolysis of difficultly saponifiable esters by means of caustic potash dissolved in diethylene glycol; the estimation of alkoxyl groups by means of copper n-butyl phthalate.

Although emphasis is mainly on semi-micro technique, numerous interesting macro methods are described, including a new form of catalytic hydrogenation apparatus for the determination of unsaturation, and gasometric methods for the estimation of urea and aromatic hydrazines.

This new volume will be indispensable to the student working for HNC and the graduateship of the Royal Institute of Chemistry, as well as for the honours man at the university.

KENNETH STUART

Note: The three parts of 'Elementary Practical Organic Chemistry' may now be bought in one complete volume, price 45s.

ECONOMICS OF PETROCHEMICALS

THE PETROLEUM CHEMICALS INDUSTRY, 2nd. edn. By *R. F. Goldstein*. E. and F. N. Spon., London. 1958. Pp. ix + 458. 95s.

At the time when the first edition of this book was published the petroleum chemicals industry had become established on a large scale in only one country—the US. Since that date the growth of the industry throughout the world and particularly in the UK and Europe has been one of the outstanding achievements of the decade. Dr. Goldstein's second revised and enlarged edition is therefore very welcome since it brings up to date the comprehensive review of the chemistry and use of petroleum-derived chemicals covered in his earlier edition. Much progress has taken place during the last 9 years in the utilisation of petroleum raw materials for the production of organic chemicals and several of the chapters in the book have of necessity been completely re-written. Two new chapters have been added to the book: on the history of the industry and on economics and statistics. In view of the growing interest in this country in the statistical and economic significance of petroleum chemicals, the latter chapter in particular adds greatly to the value of this book.

The subject matter is subdivided into the various basic types of hydrocarbon raw materials, e.g. paraffins, olefins, diolefins, aromatics, etc., and the chemistry of each type and the chemicals derived therefrom are dealt with in detail and with clarity. The subjects are well illustrated with diagrams showing the route to the more important end products and there are many excellent graphs giving yield data.

In short, a most valuable revision of a book which has now become a standard work of reference. H. P. HODGE

UK Grants Over £1m. for Overseas Research

Grants for development projects in the oversea territories approved by the UK Government in the last financial year totalled £17,380,563; an additional £1,123,850 was granted for research schemes. Research grants included £351,709 for agriculture, £106,207 for medical research, £158,830 for work on trypanosomiasis and the tsetse-fly, and £101,108 for work on insecticides. These figures are given in the 1957-8 Return of Schemes made under the Colonial Development and Welfare Acts, available from HM Stationery Office, price 2s.

Fertiliser Subsidy Rates Increased

Under the Fertiliser (United Kingdom) Scheme, 1958, the rates of subsidy for nitrogenous fertilisers (including nitrogen in compound fertilisers) are increased with effect from 1 July. The rates for phosphates are unchanged.

Chemist's Bookshelf

Pentaerythritol Derivatives

THE PENTAERYTHRITOLS. By *E. Bellow, R. H. Bath* and *J. E. Snow*. Reinhold, New York; Chapman and Hall, London. 1958. Pp. vii + 317. 80s.

The title of this book has been coined by the writers to include pentaerythritol itself and dipentaerythritol, tripentaerythritol and high members of the series. The aim, as stated in the preface, is to bring together published information on these substances in a readily accessible form; the authors certainly succeed in doing so.

After describing published methods of preparing these compounds and outlining their properties, the book lists exhaustively the derivatives which can be made from them. Naturally, most of the derivatives are those produced from pentaerythritol itself. In this, the book may be considered as an extended and up-to-date version of the earlier monograph by S. F. Marrian. Much of the information is contained in tables which give the name of the derivative, its melting or boiling point, and a note of the original reference. The remainder of the book is a review of the literature on the applications of the 'pentaerythritols'.

The book is professedly a literature review and is completely non-critical. This is of less importance to the scientific worker but detracts considerably from the value of the book to the industrial chemist. Thus, he may well read the chapter on the preparation of pentaerythritol without being able to decide which of the many alternatives described are, in fact, used in commercial manufacture. He will find that quoted descriptions of products from pentaerythritol are always in glowing terms.

Thus the statement, backed by no less than 13 references, that penthrinite (a mixture of PETN and nitroglycerine) is 'widely used as a military and industrial explosive' will hardly be accepted by those familiar with the economics of industrial explosives. Similar difficulties arise in the account of alkyd resins, one of the most important commercial outlets for pentaerythritol. Writers in the dry climate of the US can perhaps not be severely criticised for making no reference to blooming, which is experienced more in the United Kingdom; but difficulties of gelling with medium oil alkyds are general and merit more than the cursory mention made in this book.

Use of the book is made easy by complete indexes, by logical arrangement of matter and by the method of arranging references in individual chapters. The production is to the high and pleasing quality typical of the American Chemical Society monographs. The chemical worker, particularly the organic chemist, will find this book a very valuable source of references.

S. FORDHAM

Chemistry of Phenolic Resins

PHENOLIC RESIN CHEMISTRY. By *N. J. L. Megson*. Butterworths Scientific Publications, London. 1958. Pp. 323 + vii. 65s.

Dr. Megson is one of the world's experts on the chemistry of phenolic resins, and a volume such as this has been eagerly awaited by polymer chemists. Unlike developments in the chemistry of addition polymers, those on the much more complex phenolic and thermosetting resins have been more sporadic, and have often been scattered amongst chemical journals in many lands. Dr. Megson has been fortunate in securing reprints of many original papers, and has endeavoured to co-ordinate much original work. Purely technological developments have been left out, as have resins made with aldehydes other than formaldehyde.

The volume commences with a historical introduction, followed by a survey of the chemistry of the heating of phenolic alcohols, the condensation of which gives rise to phenolic resins. The work of masters such as Zinke, von Euler and Hultsch is reviewed, whilst the work of British chemists such H. S. Lilley is not ignored. The latter considers that the initial condensation is an ionic one, but that the later stages, when water is absent and the reaction proceeds in unreacted phenol as solvent, are almost certainly ionic. Much of the volume is devoted to the chemistry of phenolic alcohols. The synthetic approach is stressed, as well as the limited kinetic studies, much of which work took place in Russia or Japan, in which some attempt has been made to unravel the complex condensation involved.

One of Dr. Megson's major contributions to phenolic resin chemistry is the consideration of the fine structure of resins and resin intermediates. These are summarised in chapter 8. Considerations of restricted rotation make it probable that certain simple condensates have a rigid structure from which a number of interesting deductions are made, including the fact that a cured resite will have a numbed of voids in its structure, which accounts for certain anomalous physical properties. Fractionation and some general work are also included in this highly documented volume.

If any criticism can be made, it is that a vast amount of chemistry is considered without any final conclusions being drawn. This, however, must be attributed to the state of knowledge at the present time rather than to a defect. It must be emphasised that this is essentially a volume for the resin chemist, and not for the casual reader for whom simple accounts are available elsewhere.

H. W.

HIGH PURITY SUBSTANCES BY 'FRACTIONAL MELTING'

NBS Develops New Technique

THE US National Bureau of Standards has recently developed a new and highly versatile purification process for substances that are difficult to purify under standard conditions. The new process, called 'fractional melting' because of its close analogy to fractional distillation, was devised by A. R. Glasgow, Jr., and G. S. Ross of the Bureau's pure substances laboratory to meet the continuing demand for purer materials in scientific research. It has been applied to the purification of 2,5-dichlorostyrene, which is used as a 'potting agent' in electronic components.

Conducted in a closed, inert system under equilibrium conditions, the 'fractional melting' procedure is well suited for the purification of substances that are corrosive, hygroscopic, toxic, or reactive in air. It has several advantages over the conventional fractional crystallisation, including easy separation of contaminants and convenient purification of small samples, with a high percentage of yield.

Single Stage Operation

In general, 'fractional melting' is a single-stage operation consisting of slow equilibrium melting of a crystalline mass formed by slow equilibrium freezing. The liquid sample is first placed in an ampoule and distilled into a fractional melting tube, where it is cooled to a temperature just below the freezing point. Beginning at the bottom, crystals grow slowly from this slightly supercooled liquid. During this gradual crystallisation, the crystals formed reject the impurity until solidification is almost complete. Therefore, the bulk of the contaminant is included in the crystalline network at the top of the sample. For this same reason, the core of the crystal is uncontaminated while impurities are found in the crystal periphery.

When crystallisation is nearly complete, the tube is inverted and heat is applied at the bottom. This causes the crystals with the highest impurity content—which are then in the lower end—to melt first. As other crystals gradually liquefy and flow downward through the crystalline network, liquid from the previously melted crystals bathes each succeeding crystal surface. Since fractions of the liquid are periodically drawn off from the bottom, the less pure material is progressively displaced by liquid of higher purity. Thus the final fraction is extremely pure.

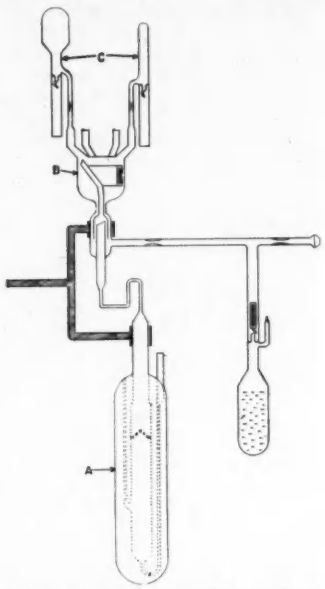
Crystals are retained within the 'fractional melting' tube chamber by a perforated glass cone. The liquid from the melting crystals flows through the cone into the distributing funnel, which directs the melted fractions into receiving ampoules. These are sealed off and removed from the system. The funnel can be rotated to various positions to fill one ampoule after the other.

For the starting operation, the glass equipment, consisting of a fractional melting tube, distributor, and receivers, is exhausted by a high vacuum system. Next, the glass tubing leading to the vacuum system is flame sealed. Following this, the sample is distilled into the fractional melting tube chamber and the ampoule, which originally contained the sample, is removed.

Constant temperature baths are used in both the freezing and melting sequences. The freezing and melting rates are controlled by using an appropriate bath and by varying the pressure in the silvered vacuum jacket. Ice and water slurries are used for samples freezing above 0°C, powdered carbon dioxide refrigerant for samples freezing above —50°C, and liquid nitrogen for substances freezing below —50°C. The temperature is regulated by means of a thermocouple inserted in the small closed glass tube connecting the sample container and the vacuum jacket.

Crystallisation may be induced by thermal-shock seeding. In this method, the small amount of sample contained in the 'U' at the bottom of the cell is frozen by cooling it with either powdered carbon dioxide or liquid nitrogen. Thus the first crystals form on the bottom and then grow upward.

When the crystallisation process is nearly complete, the tube is inverted and placed in a special Dewar-type vessel for gradual warming. For samples of 98 per cent and higher purity, the outer wall of the tube is kept at a constant temperature several degrees above the sample's freezing point; for lower purity samples (80 to 98 per cent), the outer wall is warmed slowly from the lowest crystallisation temperature to just above the freezing point of the sample.



Assembly of 'fractional melting' tube [A], distributor [B], and receivers [C]

For a maximum pure yield, it is important that the process of crystallisation be extremely gradual because this enables the crystal to form without inclusion of surrounding impurities. Slow crystallisation also produces larger crystals.

Mechanical Properties of Soviet Epoxide Resin Products

A STUDY of the thermo-mechanical properties of four Russian epoxide resins, after various crosslinking treatments, has recently been reported (Golubenkova, Kovarskaya, Akutin and Slonimskii, *Kolloid. Zhurnal*, 1958, **20** 34–37). The characteristics of the untreated resins are given in the table below:

Characteristics of Epoxide Resins

Grade	Mol. ratio of DPP to ECH	Epoxide group content %	Molecular weight
ED-5	1:5	25	400
ED-6	1:2.3	15	500
ED-13	1:1.5	8–10	1,500
ED-15	1:1.2	2–5	2,000

Epoxide resins are generally regarded as thermoplastic materials but it was found that on heating the resin ED-13 for 10 hours at 200°C a gelled product was formed, which was readily swollen by, but only partially soluble in, acetone. ED-15, with a lower epoxide content, when treated in the same way gave a tough product that retained its elasticity at high temperatures, was only slightly swollen by acetone, and was practically insoluble in this solvent. On the other hand, the same heat treatment of the other two resins, with higher epoxide contents, did not cause any significant change in their properties.

Deformation temperature curves of heat-hardened ED-13 and ED-15 are given in the above report and these show that the glass temperature, T_G, of the resins is thereby increased, more markedly in the case of ED-15.

All four resins form crosslinked, network structures, with higher T_G values, when reacted with polyethylenepolyamines, phenolformaldehyde resols and even with novolaks. In the latter case the structure is very weak.

A comparison of the equilibrium elasticity moduli of ED-5 crosslinked with (a) amines and (b) a resol, shows that in the former case the modulus is independent of temperature and in the latter case it falls with increasing temperature. This indicates that with the polyamines strong chemical bonds are involved in crosslinking, whereas with resols there are only weak physical (hydrogen) bonds.

The general conclusions drawn are that the resins of higher molecular weight, and lower epoxide group content, form crosslinked structures of higher thermal stability and greater high temperature elasticity, than those of lower epoxide content. ED-15, heat-hardened without additives, gives a product of higher thermal stability and better appearance, than the same resin crosslinked with polyamines.

People in the NEWS

● MR. J. F. WEEDON, synthesis plant manager in ammonia works at ICI Billingham Division is to become Drikold section manager in succession to MR. H. O. SMITH who is being transferred to the company's head office technical department.

● MR. C. W. ROBINSON, managing director of Uddeholm Ltd. and honorary consul for Sweden in Birmingham, has been awarded the decoration of Chevalier First Class of the Royal Order of Vasa by King Gustav VI Adolf of Sweden. Mr. Robinson is a member of the council of the Swedish Chamber of Commerce for the UK and the award was made in recognition of his services to Sweden and the country's interests. The decoration is rarely bestowed on non-Swedish nationals.

● PROFESSOR RICHARD WECK of Cambridge University has accepted an invitation to lecture at a Seminar on Residual Stresses sponsored by the American Society for Metals at Cleveland, Ohio, US from 30 October to 1 November 1958. Dr. Weck is director of the British Welding Research Association at Abington Hall, Cambridge, and chairman of the Commission on Residual Stresses of the International Institute of Welding He is author of 'Welded Structures', 'Strength of Materials' and 'Fatigue'.

● Newly elected president of the Insititute of Physics is SIR GEORGE THOMSON. DR. R. W. SILLARS has been elected a vice-president, DR. J. TAYLOR, honorary treasurer, and PROFESSOR F. A. VICK, honorary secretary. The two new ordinary members of the board elected were DR. A. C. MENZIES and DR. J. TOPPING. SIR LAWRENCE BRAGG (professor and director of the Davy Faraday Laboratory) was accorded an honorary fellowship in recognition of his contributions to the field of physics.

● Director of the new research station now being built at Stevenage for the Department of Scientific and Industrial Design for fuel and process research is MR. S. H. CLARKE, C.B.E. Mr. Clarke is at present director of the Fire Research Station at Boreham Wood, run jointly by the DSIR and Fire Offices Committee.

● Awards have been given under the Royal Society and Nuffield Foundation Commonwealth Bursaries Scheme to the following scientists for periods ranging from 2 months to over a year: PROFESSOR G. M. BADGER, Adelaide University (advances in organic chemistry, at Cambridge); DR. W. COCHRAN, Cambridge University (neutron diffraction techniques at Chalk River); MR. A. B. CRIBB, Queensland University (specimens of marine algae, in Britain); DR. R. H. ESTEY, McGill University (plant pathology and mycology, at Nottingham); PROFESSOR T. GILLMAN, Natal University (skin regeneration, principally at University College, London); DR. P. GRAY, Leeds University (free radical reactions, at Vancouver); PROFESSOR H. KLEEREKOPER, McMaster University (limnological data from Lake Moneague, Jamaica); PROFESSOR R. J. ROSSITER, Western Ontario University, (biogenesis of phospholipids, at Canberra); DR. G. SALT, Cambridge University (reactions of insect hosts to ichneumoid parasites, in W. Pakistan); MR. D. A. SCOGINGS, Natal University (photogrammetry, at University College, London); DR. T. B. TEOH, Hong Kong University (bile thrombi, at University College Hospital Medical School London); DR. C. E. WRIGHT, Plant Breeding Station, Loughgall, N. Ireland (blind seed disease in ryegrass, in New Zealand).

● MR. A. J. DUDLEY BLACK, works manager of the ICI Gaskell Marsh works, Widnes, has retired. His successor is MR. R. B. PEACOCK.

● MR. ROBERT YOUNG has been appointed chief inspector of the Salterpak division of Geo. Salter and Co. Ltd., Spring Road, Smethwick.

● MR. A. E. C. DRAKE, C.B.E., has been appointed a director of the British Petroleum Co. to fill the vacancy created by the retirement of MR. R. GILLESPIE. Mr. Drake, who has held a number of accountancy posts in the company, in 1949 became commercial superintendent in the general refineries organisation. He later acted first as manager in Baghdad, then as general manager in Iran and Iraq. Early in 1952 he visited Australia where discussions resulted in an agreement to construct the BP Kwinana refinery near Fremantle. In the same year he was appointed representative in New York and on his return to the UK in 1954 became general manager, supply and development division. In 1957, Mr. Drake was appointed a director of BP Trading Ltd., BP's principal trading subsidiary.

● MR. JOHN GRIMSTON, of Enfield Rolling Mills has been re-elected president for the coming year of the British Non-Ferrous Metals Federation. DR. M. COOK and MR. W. W. DOLTON have been re-elected vice-presidents, and MR. W. F. SLATER and MR. M. J. S. CLAPHAM have been elected vice-presidents. MR. A. L. JOHNSON has been re-elected treasurer.

● MR. F. GORDON KAY has been elected to the board of directors of Acheson Colloids Ltd. Formerly sales manager of that company, he was promoted in 1957 to the position of manager (sales relations) of Acheson Industries (Europe) Ltd., the parent body of the Acheson group.

● MR. R. H. E. THOMAS, O.B.E., has been appointed chairman of the Solid Smokeless Fuels Federation in succession to SIR HENRY JONES, M.B.E., deputy chairman of the Gas Council. Mr. Thomas is marketing member of the National Coal Board.

Wills

SIR WILLIAM BRAMWELL CARTWRIGHT, founder of W. B. Cartwright Ltd., manufacturing chemists, Rawdon, who died on 26 February last, aged 81, left £11,660 gross, £7,072 net value. (Duty paid £214.)

MR. W. S. LANCASTER, of 28 Crossway, Harpenden, Herts., chief buyer of raw materials for Laporte Chemicals Ltd., who died on 3 April, left £3,499 net.

Obituary

MR. GEORGE A. SMITH, for many years northern representative of G. H. Zeal Ltd., London SW19, died recently at Blackpool after a short illness.

J. K. Vaughan Morgan, Minister of State, BoT, left, with Bahjat Kashmula, Iraq director-general of medical supplies, and Dr. T. Kerfoot, president, Association of British Pharmaceutical Industry. Mr. Kashmula, seen here at a lunch held in his honour, has now returned to Bagdad after visiting ABPI member-firms

Commercial News

- **Coalite & Chemicals Report New Records**
- **Metal Industries Offer of BO Shares**
- **Beecham Group Sales Rose by £5 million**
- **Higher Sales Reported by British Glues**

Coalite and Chemical

New records in sales and profits have been established by Coalite and Chemical Products Ltd. in the year ended 31 March, 1958, reports Commander C. Buist, chairman. These results have been accomplished despite more intense competition. This has in fact become even more severe during the past three months.

Market conditions in oils and chemicals are reported as having been erratic. Profit margins had to be reduced in the case of certain chemicals. A pleasing feature, it is stated, has been the need to step up considerably the production of catechol, of which Coalite and Chemical are the sole manufacturers, and its derivatives, particularly tertiary butyl catechol, to meet the increasing demand for purposes of use. The range of chlorinated products has been widened and now includes *ortho-* and *para*-chlorophenols, which find a market for seed disinfectants and in the dyestuffs industry.

'Highlight of the year' has been the production in commercial quantities of a new non-toxic phosphate plasticiser (Coalite NTP) following a long, intensive, research programme. This compound is stated to widen the field of application of the company's phosphate plasticisers as the new material can be safely used in food wrappings.

Group profits increased from £340,490 to £365,814. Group fixed assets now total £1,641,626 (£1,573,076 and net current assets have increased from £1,004,128 to £1,615,122. Commitments amount to £118,000.

Dividend has been raised from 12½ per cent to 13 per cent. During the year a one-for-five rights issues reduced the unisued capital to £71,250, and it is proposed to raise the capital to £4 million by creating 20 million new 2s shares. There is, at present, no intention of issuing further shares.

Griffiths Hughes

Griffiths Hughes Proprietaries propose a final dividend on ordinary for the year ended March 1958 of 7½ per cent, making 10 per cent (7¼ per cent). Group consolidated profit for the year was £439,921 (£465,659).

Metal Industries

Metal Industries Ltd. report that their recent offer to stockholders of £1.5 million ordinary stock in the British Oxygen Co. Ltd. has been 'fully successful'.

Of the £1,297,700 stock available to ordinary stockholders under letters of entitlement, £1,257,515, or almost 97 per cent, has been taken up. For the remaining £242,485 stock, which was offered to both ordinary and preference stockholders, applications totalled £1,194,015, or nearly five times the amount available.

No stockholder, whatever the amount of his application, will receive a larger allocation of excess stock than the amount of his holding in Metal Industries Ltd. Subject to this qualification, allocations will be made on the following basis: 1. Applications for up to £50 stock—in full; 2. applications from £51 to £100—£50 each; 3. applications from £101 to £250—half the amount applied for; 4. applications from £251 to £400—£125 each; 5. applications from £401 to £500—£150 each; 6. applications for £501 and over.

Where a member holds more than one class of stock, his holdings will be aggregated for purposes of the above calculations.

Beecham Group

Total sales of the Beecham Group rose by more than £5 million to £34.15 million in the year ended 31 March, 1958. The major part of the increase is attributable to the parent and to those companies in the Western Hemisphere.

Group net profit of £2,516,397 compares with £1,867,142 in 1956-57, and the 20 per cent dividend equivalent compares with a previous equivalent of 16¼ per cent. Capital assets of £19 million compare with £18.4 million. Commitments total £900,000 (£650,000).

Head Wrightson and Co.

Gross work in hand of Head Wrightson and Co., general engineers, amounted to £22.9 million as at 31 January, 1958. Some of the larger orders will take three or four years to execute.

Group trading profits, etc., £1,757,581 (£1,466,921) were a record. The 17½ per cent dividend on larger capital represents a 2½ per cent increase.

Rhône-Poulenc

A net profit of Frs. 2,676 million as against Frs. 2,315 million for 1957 is recorded by Rhône-Poulenc of France. Fixed assets amount to Frs. 6,492 million (Frs. 5,405 million), and current assets Frs. 34,525 million (Frs. 27,879 million). Liabilities total Frs. 18,616 million as against Frs. 15,371 million.

Net dividend for 1957 is Frs. 818 per share (Frs. 938 on smaller capital).

British Glues

Orders for British Glues and Chemicals placed on capital account at balance-sheet date amounted to £60,000 and additional schemes reported in hand were estimated to cost about £120,000. The group again produced and sold more; exports were again a record.

The glue division had a good year, with high production. Turnover in the gelatine division increased. Di-calcium phosphate, the division's new product, had been well received and 'fully sold'. Sales of polyvinyl acetate and adhesives (Croid division) substantially increased, necessitating larger production facilities at Newark.

Group net profit for the year to 31 March 1958 was £351,094 (£359,547). Current liabilities amounted to £791,553 (£818,708). A dividend of 20 per cent as against 18½ per cent is being paid.

Soc. Montecatini

Presenting the annual report of Montecatini Societa, Milan, chairman, Count Carlo Faina, stressed developments in pyrites and sulphur, and emphasised, with regard to liquid and gaseous hydrocarbons, the need for fresh encouragement to be given to research and prospecting by appropriate amendments to some clauses of the Hydrocarbon Law.

Industrial chemical plants were working at full capacity last year and sales in this sector advanced over 1956 figures. At Ferrara work has started on a substantial capacity increase of cracking installations for the production of olefines. Completion of this programme is expected to increase output four times.

The increased production of plastics materials was again outstanding, particularly in polyesters where production almost doubled. Most 'gratifying results' are recorded for paints and varnishes and dyestuffs intermediates. Montecatini's synthetic fibres enjoyed increasing success. Expansion all over the world of the Fauser-Montecatini process reached an important new stage. Work started on 24 new plants, bringing the total using this process to 218, all of which will be in production shortly.

LONDON GAZETTE

Liquidator Released

FERTILIZER COMPOUNDERS LTD., regd. office, Batford Mills, Harpenden, Herts, fertiliser manufacturers. W. J. Gilbert, liquidator, released from 16 May 1958.

W. J. Fraser To Build Boots Nottingham Extension

Boots Pure Drug Co. Ltd. have awarded a contract for the supply and erection of extensions to their Nottingham works to W. J. Fraser and Co. Ltd., Romford, Essex. The plant includes a number of high quality agitated stainless steel pressure vessels which will be designed by W. J. Fraser and fabricated by them at their Barnsley Works. In some cases, fabrication will be completed on site.

Overseas Visitors to Olympia

A considerable number of overseas visitors visited the Chemical and Petroleum Engineering Exhibition at Olympia which ended on 27 June. More than 2,000, coming from 70 countries, registered their names and companies they represented.

NEW PATENTS

By permission of the Controller, HM Stationery Office, the following extracts are reproduced from the 'Official Journal (Patents)', which is available from the Patent Office (Sale Branch), 25 Southampton Buildings, Chancery Lane, London WC2, price 3s 3d including postage; annual subscription £8 2s.

Specifications filed in connection with the acceptances in the following list will be open to public inspection on the dates shown. Opposition to the grant of a patent on any of the applications listed may be lodged by filing patents form 12 at any time within the prescribed period.

AMENDED SPECIFICATIONS

On sale 30 July or as soon as possible thereafter

Bituminous compositions. Swan, R. D. **608 286**

Reaction products of glycidyl ethers. Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. **772 694**

ACCEPTANCES

Open to public inspection 23 July

Method and apparatus for controlling the heating of glass sheets. Libbey-Owens-Ford Glass Co. **798 679**

N-alkyl-tetra-hydroquinaldinic acid amides. Aktiebolaget Bofors. **798 410**

2-Phenyl-1, 3-propanediol dicarbamate. Carter Products, Inc. **798 568**

2-Methyl-2phenyl-1, 3-propanediol dicarbamate. Carter Products, Inc. **798 569**

Preparation of 1, 4-dihalo-2-butines. Dow Chemical Co. **798 411**

Fuel oil composition. Esso Standard Soc. Anon. Francaise. **798 607**

Oxidation of aralkyl compounds to aromatic carboxylic acids. General Electric Co. **798 619**

Preparation of pharmaceutical compositions. Soc. des Usines Chimiques Rhône-Poulenc. **798 680**

Apparatus for spreading pulverised or granular fertilisers. Landbouwwerktuigen-En Machinefabriek H. Vissers N.V. **798 460**

Additives to prevent the corrosion of apparatus containing hydrocarbons. Esso Standard Soc. Anon. Francaise. **798 620**

Fluidised chemical processes and apparatus therefore. Compagnie Industrielle de Procedes et d'Application Soc. Anon. [Divided out of and addition to 798 501.] **798 502**

Open to public inspection 6 August

Extraction of endocytines. Pech, J. L. **799 241**

Production of coatings. Megatron, Ltd., and Veszi, G. A. **799 222**

Catalytic hydrocarbons cracking process. Socony Mobil Oil Co., Inc. **799 482**

High molecular polyethylenes. Ziegler, K. **799 392**

Water-soluble condensation products with tanning properties. Farbenfabriken Bayer AG. [Addition to 747 675.] **799 224**

Methods for the continuous production of sulphonated organic substances. Soc. Anon. d'Innovations Chimiques dite Sinnova ou Sadic. **799 199**

Insoluble, acid and alkali-resistant carboxylic copolymers. Goodrich Co., B. F. **799 200**

Preparation of derivatives of 7, 9-pyrimidinopyrimidine-(1, 3). Thomae Ges., Dr. K. **799 177**

Classifying solid materials in a hydrocyclone. Dorr-Oliver, Inc. [Addition to 712 792.] **799 394**

Process for dyeing fibres and films of vinyl polymers and preparations therefor. Ciba Ltd. **799 374**

Complete fertilisers. Wintershall AG. **799 428**

Manufacture of alkali metal phosphates. Knapsack-Griesheim AG. **799 429**

Process and apparatus for decontaminating oils. Cabot, Inc., G. L. **799 278**

Producing phosphate material. International Minerals & Chemical Corp. **799 489**

Producing dicalcium phosphate. International Minerals & Chemical Corp. **799 490**

Electroplating with cadmium. Udylite Research Corp. **799 332**

Methods of hydrogenation. Engelhard Industries, Inc. **799 396**

Hair-waving compositions. Grein, P. F. A. [Cognate application 31425.] **799 432**

Coating or adhesive compositions. Gevaert Photo-Producten N.V. **799 184**

Manufacture of carbon black. United Kingdom Chemicals, Ltd. **799 145**

Dehydrocortical hormones. Upjohn Co. **799 493**

Preparation of iron derivatives. McNicholl, J. **799 202**

Rapid directed interesterification of glycerides. Hedley & Co., Ltd., T. **799 263**

Production of rubber-like products from paraffins. Ruhrchemie AG. **799 178**

Purification of liquid hydrocarbon fractions. Ruhrchemie AG. **799 179**

Continuous process for catalytically alkylating aromatic hydrocarbons and alkylatable hydroxy derivatives thereof in the liquid phase by means of olefins. Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. **799 186**

Phenolic amino compounds. Monsanto Chemicals, Ltd. **799 397**

Removal of condensible impurity from gases, and apparatus therefor. Stamicarbon N.V. **799 351**

Polycyclic compounds. Imperial Chemical Industries, Ltd. **799 352**

Extruded protein products. Unilever, Ltd. **799 353**

Highly polymeric polymethylene terephthalates. Imperial Chemical Industries, Ltd. [Cognate application 29307.] **799 334**

Production of alumina of high purity. Vereinigte Aluminium-Werke AG. **799 243**

Phenoxy-acetic acids having herbicidal properties. Diamond Alkali Co. **799 435**

Production of germicidal compositions. Monsanto Chemicals, Ltd. **799 400**

Manufacture of barium titanyl oxalate and of barium titanate therefrom. National Lead Co. **799 436**

Process for removing deposits of chromium on articles. Regie Nationale des Usines Renault. **799 245**

Soap compositions. Armour & Co. **799 279**

Electro-deposition of lead/indium alloys. Vandervell Products, Ltd. **799 280**

Nuclear reactors. UK Atomic Energy Authority. **799 212**

Process for removing carbon monoxide from gaseous mixtures. Soc. Per Azioni Vetrocoke. **799 310**

Extraction of liquids from fibrous or like material. Sanderson & Murray, Ltd., and Davidson, M. W. **799 438**

Method of preparing attrition resistant alumina particles. Houdry Process Corp. **799 378**

Manufacture of bottles from thermoplastic material. Dubiner, S. **799 169**

Synthetic rubber-like materials. Imperial Chemical Industries, Ltd. **799 410**

Water-soluble ammonium pentachlorophenate. Monsanto Chemicals, Ltd. **799 338**

Acridine compounds and the preparation thereof. Parke, Davis & Co. **799 361**

Production of titanium pigments. Du Pont de Nemours & Co., E. I. **799 205**

Light polarizers and process of making same. International Polaroid Corp. **799 365**

Apparatus for the electric charging of matter suspended in a gas stream. Jaschin, G. Messen-, [trading as Jaschin, G. A. Messen-[Firm of]]. **799 380**

Manufacture of polyamides. British Nylon Spinners, Ltd. **799 367**

Extractive fractionation of hydrocarbon oils by formation of urea adducts. British Petroleum Co., Ltd. **799 191**

Detergent compositions. Unilever, Ltd. **799 421**

Chlorinated butyl rubbers. Esso Research & Engineering Co. **799 193**

Manufacture of N-oxalkylated polycondensation products. Farbenfabriken Bayer AG. **799 153**

Purification of organic acids. Imperial Chemical Industries, Ltd. [Cognate application 38379.] **799 282**

Process and apparatus for the continuous production of easily vaporisable metals. Knapsack-Griesheim AG. **799 195**

Treatment of dressed poultry with antibiotic compositions to prolong the shelf life thereof. American Cyanamid Co. **799 240**

Elimination of phenol from aqueous liquors. Allied Chemical & Dye Corp. **799 327**

Epoxyalkylsuccinic acid derivatives and the process of making them. Union Carbide Corp. **799 383**

Cyano purines, related derivatives and methods of preparing them. Wellcome Foundation, Ltd. **799 384**

Preparation of steroid compounds. Pfizer & Co., Inc., C. **799 343**

Metal containers for liquids. Lloyd, N. G. **799 285**

Process for drying and/or calcining powdered granular or similar materials. Solvay et Cie. **799 251**

Flameless reaction of gaseous or vaporous saturated hydrocarbons to form olefines. Badische Anilin- & Soda-Fabrik AG. **799 371**

Manufacture of platinum-containing catalysts. Universal Oil Products Co. **799 459**

Process of treating polyamides of low molecular weight so as to increase their average molecular weight and improve their physical and chemical properties. Du Pont de Nemours & Co., E. I. **799 328**

Method of preparation of uranium chloride and fusible electrolytes containing same. Horizons Titanium Corp. **799 344**

Production of boron. Horizons, Inc. **799 385**

Method for carrying out reactions in liquid suspensions. Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij. **799 206**

Working up low pressure polyolefines. Chemische Werke Hüls AG. **799 207**

Organo siloxane-boron compositions. Midland Silicones, Ltd. **799 372**

Stabilisation of chlorinated hydrocarbons. Du Pont de Nemours & Co., E. I. **799 287**

Cracking of hydrocarbons. Badische Anilin- & Soda Fabrik AG. **799 289**

Disposal of nocuous gases containing nitrogen oxide fumes. Du Pont de Nemours & Co., E. I. **799 159**

Lubricants containing polypropylene. Esso Research & Engineering Co. **799 465**

Removing residual catalyst from resin polymerisate. Esso Research & Engineering Co. **799 198**

Antibiotic compositions containing oleandomycin. Pfizer & Co., Inc., C. **799 208**

Process of dehydrating hydrazine. Olin Mathieson Chemical Corp. **799 209**

Thiourea compounds. Monsanto Canada Ltd. **799 373**

Compositions for providing protection against light. Veritas Drug Co., Ltd. **799 467**

Production of compacted zirconium. National Lead Co. [Addition to 758 763.] **799 471**

TRADE NOTES

'Bisol' Isophorone Prices

A reduction of £20 per ton has been made by the Distillers Co. Ltd. in the price of 'Bisol' Isophorone, for deliveries in 45 gall. drums. Prices for deliveries in 5 gall. cans have also been altered.

For deliveries in 45 gall. drums, carriage paid, packages returnable at seller's expense the new schedule is as follows: 10 tons, spot or contract over the calendar year, £235 per ton; 1 ton, spot or contract over the calendar year, £237 per ton; 45 gall. drums, £240 per ton. For delivery in 5 gall. non-returnable cans, carriage paid, packages included, the cost will now be: 10 gall., £275 per ton; 5 gall., £285 per ton.

Dimethyl Formamide

A pamphlet has been issued by the Grasselli department of Du Pont dealing with the use of DMF (dimethyl formamide) as a solvent and catalyst in organic reactions. UK distributors for DMF are Durham Raw Materials Ltd., 1–4 Great Tower Street, London EC3.

ICI Titanium Prices

Imperial Chemical Industries Ltd. have revised their prices for wrought titanium. New prices (per lb.) quoted below are for 1,000lb. lots (and not for 10,000 lots as before):

Billet	Over 4" dia.—18" dia.	63s— 64s
Rod	4" dia.—.250" dia.	75s—112s
Wire	Under .250" dia.—.036" dia.	146s—222s
Sheet	8' x 2' x .250"—.010" thick	88s—157s
Strip	.048"—.003" thick	100s—350s
Tube	(representative gauge)	300s
Extrusions		120s

Courlose and Celacol

J. M. Steel and Co. Ltd., 36/38 Kingsway, London WC2, have been appointed UK distributors of certain grades of 'Courlose', the trade mark applied to sodium carboxymethyl cellulose manufactured by Courtaulds Ltd. The various grades are used for thickening, preventing coagulation, stabilising dispersions, sizing and coating. They differ in degree of etherification and in degree of polymerisation of the cellulose.

The principal varieties are as follows: *Pure grades:* Courlose F (salt-free), Courlose P (pharmaceutical); *Technical grades:* Courlose A (alkaline), Courlose N (neutralised).

J. M. Steel will distribute the F and P grades and will continue to distribute Celacol brands of methyl and hydroxyethyl methyl cellulose manufactured by British Celanese Ltd. Commercial enquiries and orders for Courlose F, Courlose P and Celacol should be sent to J. M. Steel and Co. in London, Manchester, Birmingham or Glasgow. Technical service for all three products will be provided by the chemical sales department of British Celanese Ltd. at Celanese House, London W1, or at Foleshill Road, Coventry.

New BDH Organic Chemicals

Hexachloro-propene ($CCl_3.CCl{:}CCl_2$) has been added to British Drug Houses catalogue of organic and inorganic chemicals. An almost colourless liquid, boiling at about 210°C., this compound has attracted attention in the two widely separated fields of pesticides and uranium extractions. Two US patents (2,688,529 and 2,688,530) describe methods of extracting uranium as UCl_4 from oxides of uranium by means of hexachloro-propene.

Other chemicals now listed in the catalogue are iminazole (glyoxaline), *n*-octaldehyde and 4:4¹-tetramethyl-diamino-azobenzene (p:p¹-azodimethyl-aniline.

Changes of Name

SAMUEL ROTHWELL LTD., Blackfriars House, Parsonage, Manchester 3, have changed their name to North British Chemical Co. Ltd.

EDWIN BUSH LTD., 22 Long Lane, Smithfield, London EC1, have changed their name to Armour Chemical Industries Ltd.

New Epoxide Range

Becco Chemical Division of Food Machinery and Chemical Corporation, represented in the UK by Durham Raw Materials Ltd., 1–4 Great Tower Street, London EC3, are producing a range of epoxides which includes: octylene oxide, dodecene oxide, C16-C18 olefin oxide, dipentene monoxide, alpha-pinene oxide, dicyclopentadiene dioxide, and limonene dioxide.

It is anticipated that these products will prove of use in organic syntheses, and as solvents, stabilisers, plasticisers, lubricant additives, surface active materials, corrosion inhibitors, etc.

Market Reports

Sustained Call for Plastics Materials

LONDON There has again been no outstanding feature to report on the industrial chemicals market, and the movement on home account continues to be concerned mainly with deliveries against existing contracts. The call for plastics materials has been sustained however, and buying interest has covered a wide range of chemicals, though this is limited to small quantities for current needs. The price position is strong with quotations unchanged at recent levels. Export trade enquiry is regarded as satisfactory, but shipments are below the corresponding period in 1957. Cresylic acid and creosote oil are fairly active items in an otherwise quiet coal-tar products market.

MANCHESTER Holiday conditions in Lancashire industrial centres have again left their mark on fresh bookings in textile and other chemical products on the Manchester market during the past week, and also in the flow of delivery specifications against existing commitments. The tendency among consumers to limit new business to somewhat shorter periods, a tendency noticeable in most branches of the trade at the present time, is still a feature. Hope of easier price conditions is said to be responsible, but there is little indication of a movement in this direction.

GLASGOW Trading conditions generally during the past week on the Scottish heavy chemical market continued at a fairly brisk level. Demands were for the usual range of heavy chemicals, and quantities in regard to spot and contract requirements were well maintained. Although some prices did show an upward tendency, the majority remained steady. The export market is still satisfactory with the usual volume of enquiries being received. Seasonal demands keep the agricultural chemicals market active.

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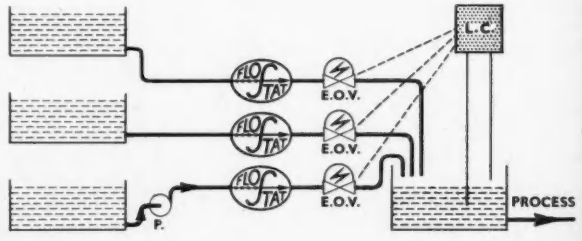

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